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In Cooperation with the
Minnesota Agricultural Experiment Station

DEPARTMENT BULLETIN No. 1271

Washington, D. C. ▼ December 12, 1924

A STUDY OF FARM ORGANIZATION IN SOUTHWESTERN MINNESOTA

By

GEORGE A. POND, Assistant Agriculturist, Agricultural Experiment Station, University of Minnesota, and JESSE W. TAPP, Assistant Agricultural Economist, Bureau of Agricultural Economics

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Farmers are constantly making changes—some at one point, some at another—all endeavoring to benefit by their own experiences and the experiences of others in so far as these come to their knowledge and are satisfactorily proven. The differences in the organization and management of farms are the results of these changes. These differences are sometimes striking; but generally they are so moderate, so numerous, and so variable in their effects on final results as to obscure the relationships of the factors of the problem of which they are only parts.

94680°—24†——1

The analytical study [1] here summarized was undertaken in order to measure the effect of differences in methods and material resources on the efficiency of farm operations, so that farmers to whose farms the results apply may make such prompt and satisfactory adjustments in their productive enterprises as will increase their returns. The farmers who contributed the details of their operations live in Cottonwood and Jackson Counties, Minn., and represent the present general scheme of farm organization and operation in effect in that section of the State. Their present practice reflects their past experience and their theory of production economics, so far as circumstances have made it possible to put them into effect.

The discussion of the data is presented in three parts:

(1) An account of the development of the agriculture of the area from the time of settlement, showing the changes in the crop and livestock enterprises, with some of the main reasons therefor, and leading up to the present conditions under which farming is conducted.

(2) A detailed statement and analysis of the amounts and distribution of labor and materials used in the production of the different crops and classes of livestock on the farms contributing data and of the miscellaneous work incident to the operation of these farms.

(3) A discussion of the principles involved in the applications of the data to the constantly recurring problems of choice, combination, and adjustment of enterprises to changing economic conditions and to other more local conditions on particular farms, together with illustrations.

DESCRIPTION AND HISTORY OF AGRICULTURE OF THE AREA

The farms studied are located in Cottonwood and Jackson Counties. They are grouped about Windom, the county seat of Cottonwood County. This city had a population of 2,123 in 1920. It is the principal market town of the community. The townships in which these farms are located are outlined on the State map in Figure 1.

The prevailing soil type in this area is a rich black bowlder clay with a pebbly clay loam subsoil. By far the larger part of the soil of southwestern Minnesota is of this type. Small areas of outwash sand and gravel are found, but they contain sufficient clay to be fairly productive. Most of this area is level. Natural drainage has to be supplemented with tile on the majority of these farms to make the entire area tillable every year. There is no natural timber except along the streams and lakes. Practically the entire acreage of every farm is tillable except for some low, undrained areas that are pastured or cut for hay.

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[1] This study was conducted cooperatively by the Division of Agronomy and Farm Management of the Minnesota Agricultural Experiment Station and the Division of Cost of Production and the Division of Farm Management of the Bureau of Agricultural Economics, U. S. Department of Agriculture. The authors wish to acknowledge the valuable assistance received from the chiefs and staffs of these divisions in outlining and developing this study, and especially in their careful and thorough review of the manuscript. They also wish to thank Donald Jackson of the Division of Statistical and Historical Reserach, Bureau of Agricultural Economics, who assisted in the collection of the historical data, Russell C. Engberg and Andrew T. Hoverstad of the Division of Agronomy and Farm Management, Minnesota Experiment Station, who assisted in collecting and tabulating the data and preparing them for tabular and graphic presentation, and C. O. Ruud, route statistician at Windom, Minn., who collected the data in the field. The thanks of the authors and of the departments making this study are due the following farmers for their cooperation in furnishing these data: Andrew T. Anderson, Ralph Asquith, Lewis Behrens, Matt Brugman, Guy Dryden, Merton W. Dyer, John Eidem, Frank Engle, Brown Erickson, H. A. Frederick, Walter L. Frost, Arnold Graue, Albert Grunenwald, John F. Gustafsor, Herbert Hocke, John R. Jacobson, Perry M. Jencks, J. E. Johnson, Clarence E. Morton, Andrew Olson, Henry F. Otto, Emil Paulson, George Price, H. M. Rasmussen, Arnold Riedesel, John W. Satorius, Arthur Schaffer, E. H. Showman, Lester H. Smith, Sogge & Nerness, Henry J. Thake, John E. Timmons, Ben Vaske, H. H. Wier, Henry Will, and K. E. Wing.

Data covering the climatic conditions in the Windom area for the three years of this study and for the 10-year period (1913–1922) are presented in Table 1.

Location of the Area Studied

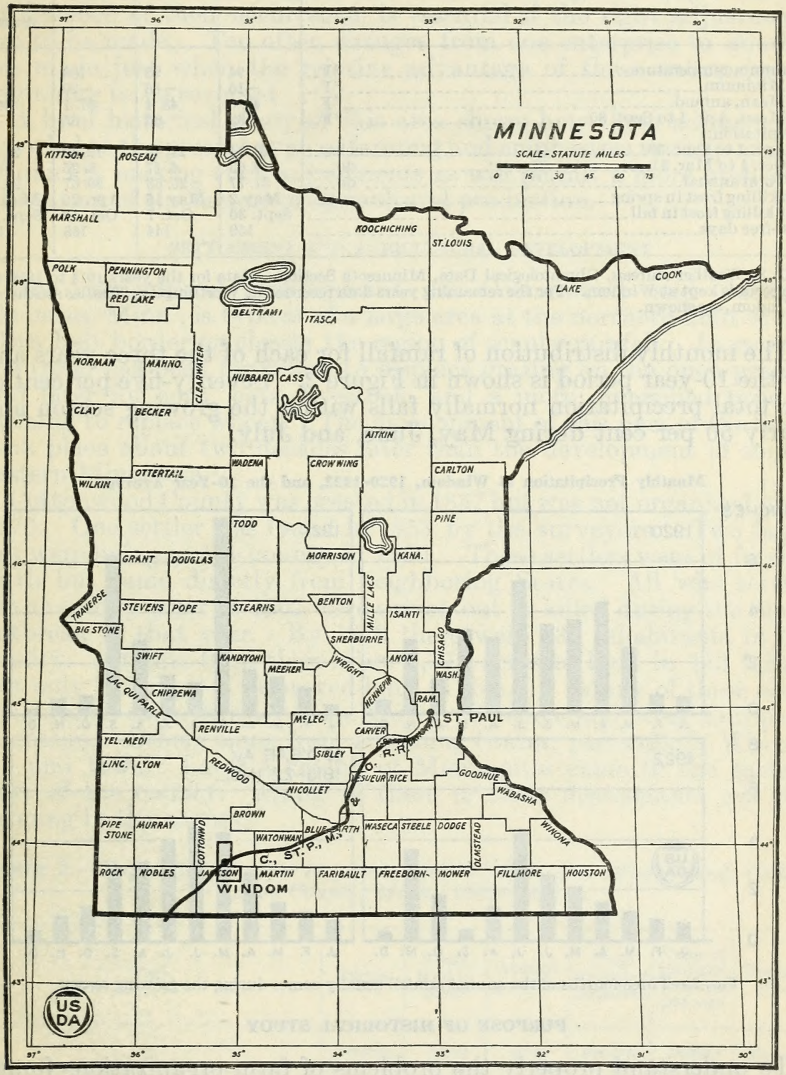

FIG. 1.—The area studied is located in the northern edge of the corn and oats belt and south of the spring-wheat area

TABLE 1.—*Climatic conditions—Windom, 1913–1922* [1]

	1920	1921	1922	10-year average 1913–1923 minimum
Maximum temperature °F	94	95	100	95
Minimum °F	−16	−16	−20	−21
Mean, annual °F	46.0	48.4	47.1	44.6
Mean, Apr. 1 to Sept. 30 °F	62	66	65	62
Precipitation:				
Apr. 1 to Sept. 30 inches	23.14	21.46	12.42	21.77
Oct. 1 to Mar. 31 do	8.63	4.17	8.25	6.95
Total annual do	31.77	25.63	20.67	28.72
Last killing frost in spring	May 2	May 15	Apr. 26	May 11
First killing frost in fall	Sept. 30	Oct. 7	Oct. 12	Sept. 30
Frost-free days	150	144	168	141

[1] U. S. Weather Bureau, Climatological Data, Minnesota Section. Data for the years 1914 to 1918 are from records kept at Windom. For the remaining years data recorded at Worthington, 30 miles southwest of Windom, are shown.

The monthly distribution of rainfall for each of the three years and for the 10-year period is shown in Figure 2. Seventy-five per cent of the total precipitation normally falls within the growing season and nearly 50 per cent during May, June, and July.

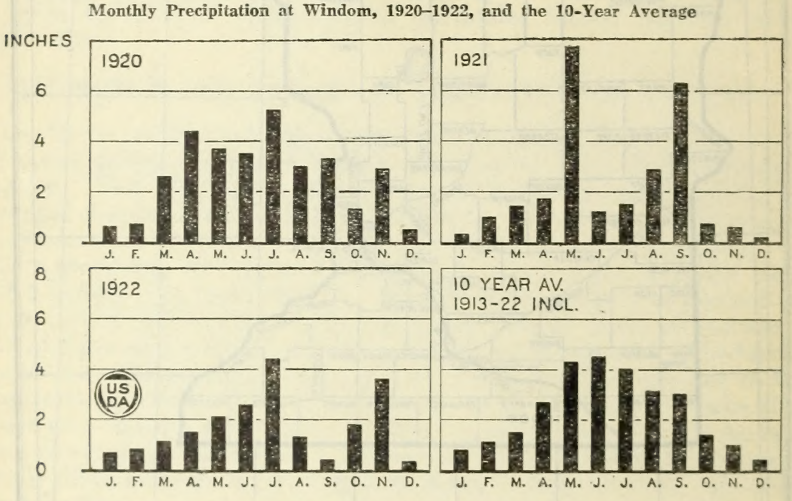

FIG. 2.—Three-fourths of the annual rainfall usually comes during the growing season

PURPOSE OF HISTORICAL STUDY

To understand properly the problems of farm organizations found in the area at present, it is necessary to know something of the development of the area and the factors which made this development what it has been.

With the development of a new area, changes in the acreage of crops and in the number and kinds of livestock are largely the results of expansion and of efforts to discover those lines of production best adapted to the soil, climate, and other conditions. Once the physical possibilities of crop and livestock production become known, subsequent changes in the relative importance of different lines of pro-

duction are the result of changes in economic conditions which affect the profitableness of different enterprises. Such changes may be only temporary or they may be of a more permanent nature. A proper appraisal of the significance of these changes as they occur, or in advance of their occurrence, is essential if the right adjustments are to be made. Too often changes from one enterprise to another are made just when the relative advantage of these enterprises is beginning to be reversed.

A brief historical study of this area shows how these adjustments have led to the present type of farming and emphasizes the importance of quickly making such adjustments as will permit a more profitable utilization of the factors of agricultural production.

SETTLEMENT AND AGRICULTURAL DEVELOPMENT

The agricultural development of Cottonwood and Jackson Counties, Minn., is typical of a large area at the northern limit of the Corn Belt bordering closely the region of scanty rainfall. In general the trend has been for wheat to displace grazing on the open prairie, and later for corn, oats, livestock, and a more diversified type of farming to replace wheat. The development of this part of the State took place about two decades later than the development of southeastern Minnesota.[2]

Cottonwood County was created in 1857 but was not organized until 1870. One settler was found in 1853 by the surveyors. Two families were living in the county in 1860. These settlers were of foreign birth but came directly from neighboring States. All who settled in the county prior to 1862 were driven out or killed during the Sioux outbreak of that year. By 1870 there were 535 inhabitants in the county. At this time there were 6,377 acres of land in 143 farms, but only 782 acres of improved land (Table 2). Many of these early inhabitants came directly from Norway, Sweden, and other European countries. Others came from adjoining States, particularly Wisconsin and Iowa. Later a colony of Mennonites came to the eastern part of the county. Many of these or their descendants are still farming in the county.

TABLE 2.—*Population, number of farms, land in farms, and value of land, Cottonwood County, Minn., 1860–1920*

Year	Farms	Total land in farms	Average per farm	Total farm land improved	Value of land and buildings per acre	Population
	Number	*Acres*	*Acres*	*Per cent*	*Dollars*	*Number*
1860	2	260	130	23	10.00	12
1870	143	6,377	45	12.3	6.54	535
1880	1,082	171,413	158	40.6	14.86	5,533
1890	1,142	208,078	182	59.8	13.49	7,412
1900	1,568	370,715	236	92.2	26.33	12,069
1910	1,580	371,496	235	91.2	50.11	12,651
1920	1,801	380,043	211	90.7	153.11	14,570

[2] The statistical study of the history of this region is confined to Cottonwood County. The development in Jackson County was not different in any important respect.

The period of most rapid development in Cottonwood County was from 1870 to 1900. The railroad reached the county in the summer

of 1871 and this greatly facilitated the expansion which took place during the seventies. During the period from 1870 to 1900 the population increased from 535 to 12,069 and the number of farms from 143 to 1,568. At the same time, the average acreage per farm was rapidly increasing as well as the improved acreage. Table 2 shows that there has been little change in the percentage of improved land in farms since 1900. The value of land and buildings per acre doubled from 1870 to 1880, decreased slightly from 1880 to 1890, and doubled again between 1890 and 1900. By 1900 the major part of the land in the county was in farms and of this 92 per cent was improved.

From 1900 to 1910 there was very little change in the population of the county and no significant change in the number of farms, total land in farms, or average acreage per farm, but the price of land almost doubled. The census of 1920 revealed a substantial increase in number of farms with a corresponding decrease in the average acreage per farm. The total land in farms and improved land in farms increased slightly, while the price of land and buildings per acre increased from $50 to $153.

CHANGES IN ACREAGES OF IMPORTANT CROPS

The crops which have been most important in the development of southwestern Minnesota are wheat, oats, barley, flax, and corn. Figure 3 shows the distribution of the total grain acreage from 1870 to 1920. During the period of expansion from 1870 to 1900, the acreage of most of the grain crops was increasing. Changes in the relative importance of the different grain crops are shown in a general way by the changes in the percentage distribution of the total grain area in Figure 3.

The early settlers devoted most of their attention to the production of wheat, oats, and corn. From the beginning wheat occupied the most prominent place and, with the exception of a few temporary changes incident to grasshopper damage and unfavorable seasons, continued to do so until about 1905. During the years 1873, 1874, 1875, and 1876 the small grain and corn crops were almost entirely destroyed by migratory grasshoppers. As a result, the percentage of the total grain acreage in wheat was reduced from 72.3 in 1872 to 43.5 in 1876, and the relative importance of corn increased. No recurrence of grasshopper damage has taken place since 1876, but the severe damage from this source caused the abandonment of many farms in the area. There was a 40 per cent decrease in the total grain area from 1875 to 1876. An unusually good wheat yield in 1877 encouraged a continuance of expansion, and again wheat overshadowed all other crops in importance.

The expansion that followed the disappearance of the grasshoppers was soon checked by a general decline in grain prices and a combination of circumstances which resulted in low wheat yields. The seasons of 1880 and 1881 were wet and unfavorable to wheat. There was a slight shift from wheat to corn on this account for three years. Also, wheat frequently returned a very low yield or failed entirely on land broken out of prairie one or two years. The growing of flax helped to remove this difficulty, and this crop rapidly increased in importance during this period. During the years 1881

to 1886, flax occupied from 25 to 40 per cent of the grain acreage, while wheat occupied only 19 to 38 per cent. The extent to which

Distribution of the Grain Acreage in Cottonwood County and the Prices of Grains from 1872–1920

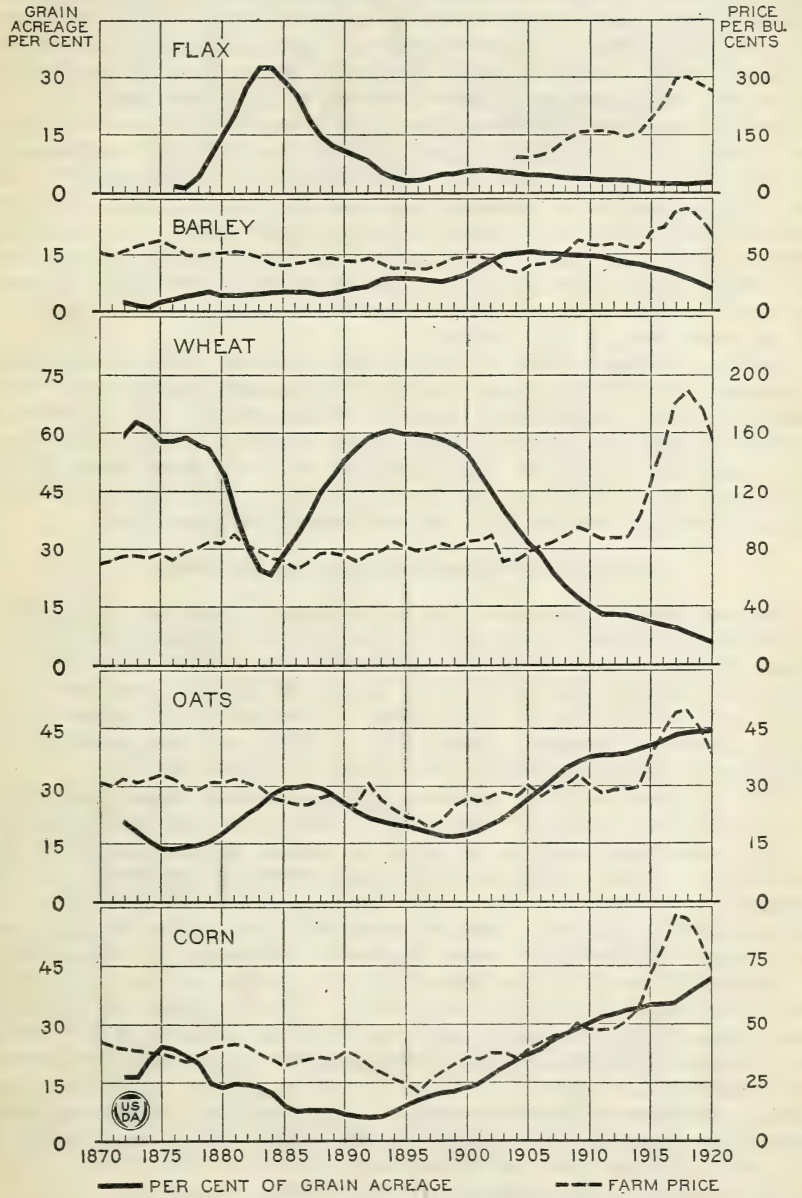

FIG. 3.—Five-year moving averages of the percentage distribution of the grain acreage in Cottonwood County and of the December 1 farm prices of grains in Minnesota, 1872–1920. Corn and oats have replaced wheat

this expansion in flax acreage was the result of high prices of flaxseed can not be determined as no data on prices are available. The gen-

eral expansion of the total grain acreage began again in 1886 and continued until the end of the nineties.

About 1900 there began a rapid shift away from wheat toward oats and corn. Prior to this time the production of these crops was confined principally to the needs of the work stock, cattle, and hogs kept on the farms. Unfortunately no data are available on the yields of wheat obtained during the period when the shift was made. Interviews with men who were farming at the time seem to substantiate the opinion that low wheat yields as a result of rust damage, hot winds, and depletion of soil fertility were largely responsible for the rapid change; and they attached much significance to the fact that a number of farmers came into the country from the corn area of Iowa during this period, bringing with them a better knowledge of the proper practices in corn growing that resulted in improved corn yields. Also, the development of varieties of corn better adapted to conditions in the area was a significant factor in the expansion of the corn crop in this region.

For the last four years for which data on local yields of crops are available (1919–1922), those for corn, oats, and barley have been relatively more satisfactory than the wheat yields. No significant shifts in the relative prices of these crops occurred during this period. Corn and oats began to replace wheat as cash grain crops about 1905, and since 1910 wheat has been relatively unimportant. Wheat prices have not been quoted on local markets since 1916.

CHANGES IN NUMBERS AND KINDS OF LIVESTOCK

Increase in the importance of the different classes of livestock in Cottonwood County, with few exceptions, has followed the general trend of the expansion of the cultivated area. The classes of productive livestock that have been important in this area are hogs, dairy cattle, beef cattle, and sheep. Changes in the numbers of these classes of livestock from 1872 to 1920 and the prices of the different livestock products are shown in Figure 4.

Strictly speaking there has never been a large number of cattle of a purely dairy type in the county. The cattle are principally of a type commonly known as dual purpose. During most of the period from 1870 to 1890 the milk cows were kept primarily for the production of milk for use on the farms and for the calves raised. Beginning with the latter part of the eighties the production of butter for eastern markets has been gradually increasing in importance.

From 1870 to 1890, "other cattle" [3] consisted of oxen used for farm work and the young stock raised. The expansion of livestock enterprises during the early years was held in check by lack of feeds as a result of low yields during the periods of grasshopper damage and unfavorable seasons and because of inability to obtain loans for the purchase of breeding stock. Cattle have never been shipped into these counties for feeding on any large scale. The period of the early nineties was one of low beef prices, and there was a temporary decline in the number of other cattle produced.

Dairy and other cattle provide a market for the supplies of natural pasture, wild and tame hay, and other nonmarketable feeds common

[3] "Other cattle" include all cattle other than cows.

to the area. The cows also provide productive employment for labor during the winter months, when little or no crop work can be

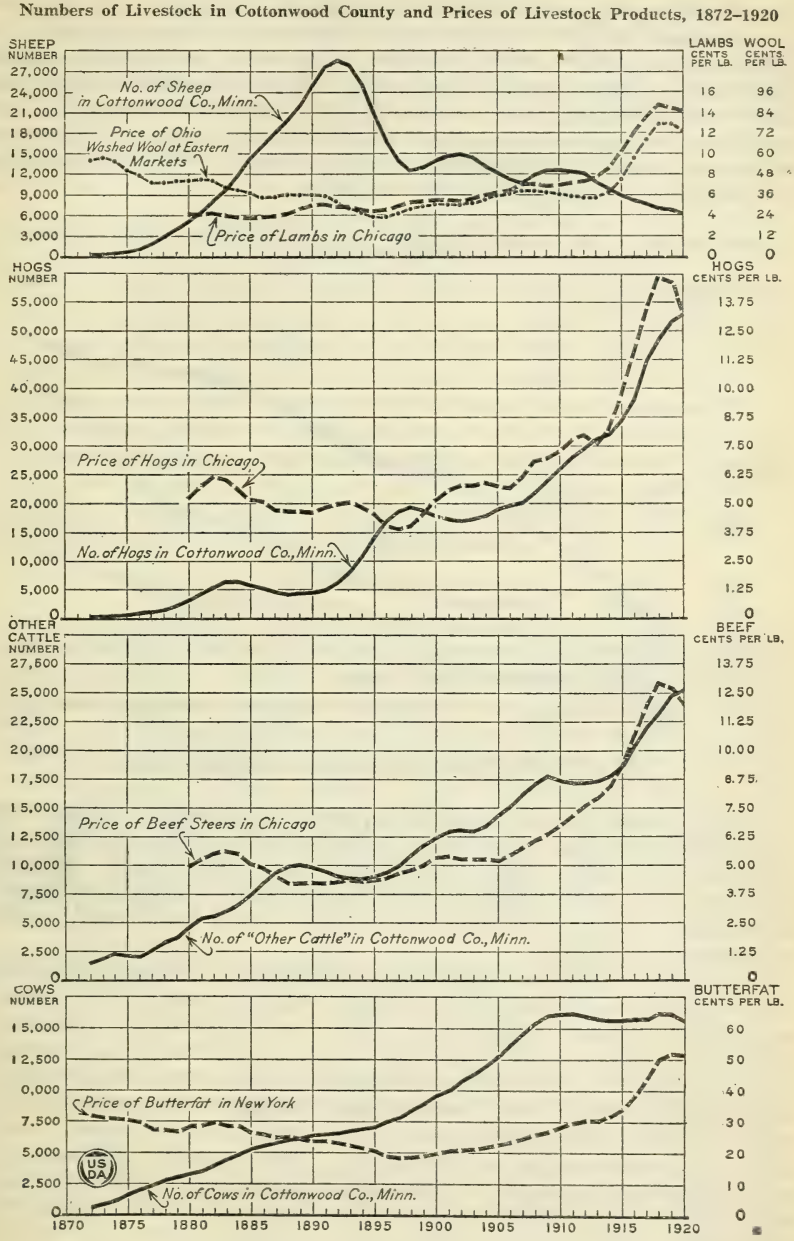
Numbers of Livestock in Cottonwood County and Prices of Livestock Products, 1872–1920
SHEEP NUMBER
LAMBS CENTS PER LB.
WOOL CENTS PER LB.
No. of Sheep in Cottonwood Co., Minn.
Price of Ohio Washed Wool at Eastern Markets
Price of Lambs in Chicago
HOGS NUMBER
HOGS CENTS PER LB.
Price of Hogs in Chicago
No. of Hogs in Cottonwood Co., Minn.
OTHER CATTLE NUMBER
BEEF CENTS PER LB.
Price of Beef Steers in Chicago
No. of "Other Cattle" in Cottonwood Co., Minn.
COWS NUMBER
BUTTERFAT CENTS PER LB.
Price of Butterfat in New York
No. of Cows in Cottonwood Co., Minn.
USDA
1870 1875 1880 1885 1890 1895 1900 1905 1910 1915 1920

FIG. 4.—Five-year moving averages. Sheep grazing during the early years has been followed by production of beef cattle and hogs, and some dairying

done. These factors have no doubt been of much importance in the expansion of the dairy and mixed-cattle enterprise in the area.

It was not until the wheat crop began to decline in relative importance that the production of beef and pork reached any significant proportions. During the two decades, 1900 to 1920, the relative increase in the importance of hogs and "other cattle" was closely related to the rapid increase in the total production of corn. (Figure 5.) Prior to 1895 hogs were kept primarily for the production of pork for local consumption. Since that time the two significant factors in the increase in pork production are the general increase in pork prices and the rapid increase in the production of corn during the period from 1900 to 1919.

Relation between the Corn Acreage and the Numbers of Hogs and Other Cattle in Cottonwood County, 1895–1920

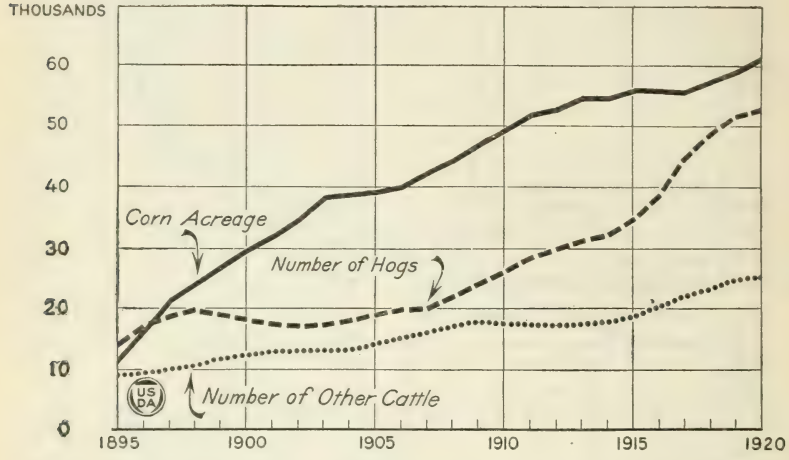

FIG. 5.—Five-year moving averages. Expansion of the corn acreage in this area has been followed by the production of larger numbers of hogs and beef cattle

Sheep formed a very important class of livestock in this area from about 1880 to 1895. They were brought in to utilize the large areas of pasture not under cultivation during those early years. With the passing of the range pasture and the increase in improved land in farms that took place during the nineties, there was a rapid decline in the number of sheep.

It is evident that in response to changing conditions individual farmers have been continually making adjustments in the kinds of crops and livestock produced. This has resulted in a complete shift from a system of cash-grain farming with wheat as a major crop to a system of livestock and grain farming with corn and oats the principal crops and these largely marketed through the livestock. Conditions affecting the profits in different lines of production will continue to be dynamic. Consequently, farmers who would secure the greatest continuous returns must constantly make adjustments in the relative size and methods of conducting different enterprises.

STUDY OF PRESENT-DAY AGRICULTURE IN COTTONWOOD AND JACKSON COUNTIES

METHOD OF SECURING DATA

To determine how farmers might make these adjustments, an analysis of the data showing the requirements and returns of different enterprises on the farms of this area has been made. These data were secured by the complete cost route method. The study was begun in March 1920. Twenty-four farms in the vicinity of Windom as nearly representative of the farms of the area as possible were selected. The farmers made a record of all cash receipts and expenses, of the amounts of labor used on different crops and livestock, quantities of feeds fed to livestock, of crop and livestock production, etc. These records were collected by a route man stationed at Windom who visited each farm two or three times each week. Inventories were taken at the beginning and close of each year. All fields were accurately measured each year and the crop acreage determined. The data presented were obtained during the years 1920, 1921, and 1922. Of the 24 farmers who co-operated in the work each year, 6 moved away during the year and 1 failed to furnish usable records. During the three years, 65 complete farm records were secured. Altogether 36 different farms are included in this study. Records from 7 were obtained for three years, from 15 for two years, and from 14 for one year.

SIZE OF FARM AND DISTRIBUTION OF CROP ACREAGE

The average size of the farms studied was 187 acres. Of these, 137 acres were in crops, 40 acres in pasture, 5½ acres in farmstead, and the remainder in waste land. The total acreage is slightly less than the average for the two counties, but the crop acreage is slightly greater. The distribution of crop acreage on these farms is shown in Table 3. This distribution is also compared with the distribution for all farms in the two counties. The farms studied had a larger percentage of land in corn, less in wild hay, and less in miscellaneous crops such as wheat, buckwheat, soybeans, sorghum, beans, and potatoes, than did the two counties as a whole. However, they are probably as typical of the general type of farming in the area as could be selected.

TABLE 3.—*Distribution of crop acreages on farms studied and on all farms in Cottonwood and Jackson Counties*

Crop	Farms studied [1]						All farms cottonwood and Jackson counties.[2] Total crop acreage
	Total acreage	Farms growing this crop	Acres per farm			Total crop acreage	
			Average	Maximum	Minimum		
		Number				*Per cent*	*Per cent*
Corn	3,852	65	59	130	8	43.4	32.2
Oats	2,818	64	44	107	8	31.7	33.9
Tame hay	954	48	20	60	1	10.7	8.8
Wild hay	507	38	13	39	1	5.7	11.9
Barley	317	18	18	39	4	3.6	3.4
Rye	194	11	18	35	6	2.2	2.7
Alfalfa	124	21	6	94	2	1.4	.2
Flax	69	6	12	30	2	.8	1.5
Miscellaneous crops	48	42	1	12	1	.5	5.4

[1] Average for 65 farm years, 1920 to 1922, inclusive. [2] Data from the census for 1919.

CROPPING SYSTEM AND ROTATION

Corn is the principal crop grown in the area and the cropping system is built around it. Although no definite rotation is followed, the usual practice is to follow small grain with corn, and to keep the same land in corn for two years in succession. Fifty-four per cent of corn followed small grain, 34 per cent followed corn, and 12 per cent followed a grass crop during the three years. There was an increasing use of grassland for corn. In 1921 and 1922 three times as large a percentage of corn was planted on sod land as in 1920. The oats and barley crops usually follow corn. In 1922, 95 per cent of the oats acreage followed corn. This practice is increasing; only 76 per cent followed corn in 1921 and 67 per cent in 1920. Rye follows other small grain, because the corn crop is not harvested in time to seed the rye. Flax is grown on wild-hay or pasture land that has just been broken up. It is the first crop on new breaking, but is seldom grown on land that has been previously cultivated.

DESCRIPTION OF LIVESTOCK

The number and kinds of livestock on the farms studied are shown in Table 4. A comparison is also made between these farms and the average for all farms in the two counties. The farms studied are somewhat more heavily stocked than the average farms of these counties.

TABLE 4.—*Number of head of livestock per farm for the farms studied and for all farms in Cottonwood and Jackson Counties*

Kind of stock	Farms studied [1]						All farms,[2] Cottonwood and Jackson Counties average per farm
	Farms reporting	Head	Number per farm reporting			Average all farms	
			Average	Maximum	Minimum		
Work horses	65	404	6.2	10.9	3.4	6.2	6.2
Colts	43	110	2.6	7.7	0.1	1.7	1.5
Cows	65	684	10.5	29.8	3.1	10.5	9.6
Other cattle	65	1,292	19.9	74.2	2.9	19.9	13.4
Swine	65	2,360	36.3	128.4	9.1	36.3	30.0
Poultry	65	8,078	124	300	25	124	112
Sheep	28	711	25.4	59.3	1.7	9.1	2.6

[1] Average for 65 farm years, 1920 to 1922, inclusive. [2] Data from census taken as of Jan. 1, 1920.

Horses are the principal source of motive power on the Windom farms. Two or three farms used tractors each year; these averaged 119 hours of field work and 12 hours of belt work per year. One farm in 1921 and two farms in 1922 used an auto truck for some hauling. Practically every farm has an automobile that is used for light hauling, such as delivering cream or purchasing supplies. Otherwise all field and hauling work is done by horses. These horses are practically all of common-grade stock, averaging around 1,300 and 1,400 pounds in weight.

A few colts are raised on most of the farms, largely for maintaining the work-horse enterprise. Any surplus over this need is sold. Usually the colts are not sold, until after they have been broken and

worked for some time. Seven colts were foaled on the 36 farms each year of this study. This number would little more than offset the death loss of work horses.

There are few strictly dairy cattle on these farms. Most of the cattle are either of beef breeding or of the general-purpose type often classed as "dual purpose." For discussion in this bulletin, all cattle are divided into three classes: Dairy cows, young dairy stock, and mixed cattle. Dairy cows include all cows in those herds in which the calves are weaned soon after birth and the cows milked by hand throughout their lactation. Young dairy cattle [4] include all cattle on these same farms not listed as dairy cows. As soon as a heifer freshens she is transferred from young dairy cattle to dairy cows and so classified during the rest of her life in the herd whether milking or dry.

The mixed-cattle enterprise includes all cattle on those farms where the cows are allowed to nurse their calves during part or all of their lactation. In these herds, part of the cows may be milked by hand all of the time; and most of them, except the pure bred beef cattle, are milked by hand at least part of the time. However, since a complete record of the production for the herd could not be obtained, they are not classed with the dairy cows for which complete milk production records are available. Most of the individuals in both the dairy and mixed herds are rather plain ordinary cattle. The cows are only fair milkers and few beef steers of high quality are produced. They are fairly representative of the great majority of cattle raised in the general area.

The hog enterprise has been the largest source of income on these farms during the three years of this study. They have furnished more than one-third of the gross income. Hogs are the best bred of any class of stock in this area. Purebred boars are used on all farms, and in many cases purebred sows are used.

Sheep are a minor enterprise on most farms. Usually the flocks are so small that they require little care and can pick up most of their living about the farm and farmstead.

Poultry is only a side line on these farms. Enough chickens are raised to supply the table with eggs and poultry and a small surplus to exchange at the store for groceries and supplies. Most of the flocks are of the general-purpose or American breeds.

UNIT REQUIREMENTS OF LABOR AND MATERIALS FOR CROPS

In any study of the crop phase of farm organization it is essential to know the basic unit requirements [5] for the production of the various crops commonly grown in the area studied. These data include hours of man labor, hours of horse labor, pounds of seed, pounds of twine, and quantities of other material required in the production of the several crops. It is also important to know the seasonal distribution of this labor and the probable days available for the various crop operations. Since any study of unit requirements shows a wide variation between different farms, even in the same

[4] Young dairy cattle correspond to "other cattle" as defined in footnote 3, page 8.

[5] The term "unit requirement" as used in this bulletin, implies unit consumption or expenditure of labor, seed, feed, and other factors of production under conditions as they exist rather than the implication that this consumption or expenditure is a fixed physical necessity. For example, if 3 man hours and 12 horse hours per acre are listed as the labor requirement for plowing on a given farm, this simply means that this particular farmer expended this amount of labor in plowing an acre of land.

locality where soil and climatic condition are rather uniform, these data are presented in tables showing the range of requirements for the individual farms.

In addition to the range of requirements for the single year[6] the average for that year and for the preceding and succeeding years are shown; and the factors causing variations are indicated in order that a farmer wishing data applicable to his individual farm may find requirements covering conditions similar to those under which he is working.

In addition to the range of requirements for the different farms and averages covering all farms, standard requirement data are shown. These standard requirements represent what may be reasonably expected for cultural practices most characteristic of the area under good management. They are lower than the average, mean, or modal requirements and represent approximately the attainment of those farmers who are found among the upper 25 per cent in the scale of labor efficiency as measured by low labor requirements for a given operation. They are intended to serve as a measure or standard by which the individual farmer may, by comparison with his own requirements, check the effectiveness with which he utilizes his labor in performing the various operations. In addition to the time actually spent in motion in the field, a reasonable allowance is made in computing these standard requirements for time unadvoidably lost in going to and from fields, adjusting machinery, making necessary minor repairs on harness and machinery in the field, resting teams, delay by showers, and other losses of time necessarily incident to the operation.

SEED-BED PREPARATION

Since the operations involved in preparing the seed bed, such as plowing, disking, and harrowing, require practically the same amount of labor to cover an acre once over regardless of the crop for which the ground is being prepared, their labor requirements are presented in one table independent of the individual crop tables. Both man and horse labor requirements for these three operations on the basis of 1 acre are shown in Table 5.

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[6] The range of requirements for the year 1921 is presented in unit requirement tables. The middle year of the three was selected in order that a comparison with the preceding and succeeding years might be shown. On account of the replacement of some farms in the study one year by others the next, there is much less difference in the composition of the group between two successive years than between 1920 and 1922. Then, too, 1921 was more nearly a normal year from the standpoint of climatic conditions. A wet, cold spring in 1920 delayed the whole season's program of work and interfered abnormally with seed-bed preparation and the summer of 1922 was so hot and dry as to make that season abnormal, especially for hay and corn.

TABLE 5.—*Man and horse labor requirements per acre by operations for seed-bed preparation, 1921*

Plowing			Disking			Harrowing		
Farm No.[1]	Hours of labor		Farm No.[1]	Hours of labor		Farm No.[1]	Hours of labor	
	Man	Horse		Man	Horse		Man	Horse
3	1.81	8.60	13	0.33	[4] 0.09	3	0.19	0.76
10	1.94	[2] 8.18	3	.45	1.80	18	.19	.76
13	2.17	([5])	10	.43	1.98	9	.22	.81
1	2.19	8.68	1	.47	1.88	7	.23	.98
6	2.32	9.43	4	.48	1.85	13	.23	.87
2	2.35	9.90	7	.49	2.26	10	.23	1.13
4	2.35	10.60	2	.50	1.90	5	.23	.83
19	2.96	11.59	11	.50	1.73	1	.24	.84
11	2.99	9.59	5	.51	2.04	4	.24	.96
8	3.06	11.37	20	.53	1.86	8	.26	.92
22	3.12	12.48	6	.54	2.18	2	.26	1.04
12	3.12	13.95	9	.55	2.50	6	.27	1.04
7	3.13	11.95	19	.57	2.76	20	.27	.94
18	3.21	[3] 9.63	14	.58	2.90	12	.29	.92
16	3.22	10.64	8	.58	2.26	19	.29	1.12
5	3.23	10.94	16	.59	2.00	17	.32	1.29
21	3.27	10.03	12	.60	2.31	21	.34	.95
9	3.31	13.78	18	.62	2.71	16	.35	1.31
14	3.33	15.73	15	.63	2.52	14	.35	1.41
15	3.47	10.25	17	.68	2.62	11	.39	1.16
20	3.66	10.98	22	.71	2.70	15	.46	1.28
17	4.34	14.29	21	.84	2.97	22	.46	1.84
Average 19 farms, 1921 [6]	2.83	10.94	Average 21 farms, 1921 [6]	.54	2.20	Average 21 farms, 1921 [6]	.27	1.02
Average 17 farms, 1920 [6]	2.66	9.73	Average 19 farms, 1920 [6]	.59	2.40	Average 20 farms, 1920 [6]	.29	1.11
Average 18 farms, 1922 [6]	2.95	11.40	Average 20 farms, 1922 [6]	.52	2.23	Average 21 farms, 1922 [6]	.29	1.10
Average 54 farm years [6]	2.81	10.69	Average 60 farm years [6]	.54	2.26	Average 62 farm years [6]	.29	1.08

[1] Farms are arrayed in order of man-labor requirements beginning with the lowest.
[2] In addition to the horse hours, 0.14 tractor hour per acre was used for plowing.
[3] In addition to the horse hours, 0.41 tractor hour was used per acre for plowing.
[4] In addition to the horse hours, 0.31 tractor hour per acre was used for disking.
[5] Instead of horse hours, 2.17 tractor hours per acre were used for plowing.
[6] Data from farms using tractors omitted in calculating these averages.

CAUSES FOR VARIATION IN LABOR REQUIREMENTS FOR SEED-BED PREPARATION

The 7 farms having the lowest man-labor requirements per acre used gang plows largely. Two-bottom gangs and 4 or 5 horse teams were used except on Farms 10 and 13, where part or all of the plowing was done with 3-bottom gangs and tractors. On the remaining 15 farms 16-inch sulky plows and 3-horse teams were used on all but 3. Both man and horse labor requirements were lower where gang plows were used. On farm 3 with the lowest man-labor requirement, most of the plowing was done with a 5-horse team. Man-labor requirements for harrowing were in general less where 4-horse teams were used than where 3-horse teams were used. Man-labor requirements increase as the ratio of man labor to horse labor increases.

The size of the horses also affects the rate of plowing. The number of hours of horse labor required to plow an acre on farm 14 was nearly 50 per cent greater than on farm 4, although there was considerable sod plowing on the latter and only stubble plowing on farm 14. The land on farm 4 was plowed more deeply. The lower horse-labor requirement on farm 4 in spite of the more difficult plowing was due in part at least to the fact that four horses averaging 1,800 pounds in weight were used on a 14-inch 2-bottom gang plow, whereas five horses were used on the same sized implement on farm 14, but these horses averaged less than 1,400 pounds

in weight. Low labor requirements for disking on farm 4 are likewise affected by the use of the large horses. On the 10 farms having the lowest labor requirements for harrowing, 4-section harrows cutting 22 to 26 feet were used on all but 1. Of the 10 with the highest labor requirements, a 22-foot harrow was used on 1, a 20-foot on another, and smaller harrows on the others. The man-labor requirement for disking on farm 13 was low on account of the use of a tractor and tandem disk.

The lowest labor requirements are found on farms having the largest fields. On farms 1, 3, and 6, having the lowest labor requirements for plowing with horses, the average size of field was 39 acres. On farms 15, 17, and 20, with the highest labor requirements, the average size of field was 13½ acres. Distance of fields from farmstead also affects labor requirements. On farm 5, although the fields were large and the horses much larger than the average, the labor requirements were high, because fields composing about one-third the acreage plowed were nearly 2 miles from the farmstead,[7] whereas on most of the farms few fields were over one-fourth of a mile from the farmstead.

On farms 1, 3, and 4, with low labor requirements for disking, the fields averaged 27¼ acres; and on farms 17, 21, and 22, having high labor requirements, the average size of field was only 8½ acres. Much time is lost in turning around and in working the headlands on the smaller fields.

Sod plowing requires more labor than stubble plowing. Most of the plowing included in this study is stubble plowing. The high labor requirements on farm 17 are due in a large measure to the fact that the acreage plowed included some permanent pasture with a tough bluegrass sod.

STANDARD REQUIREMENTS PER ACRE FOR SEED-BED PREPARATION OPERATIONS

The following are suggested as standards of accomplishment in seed-bed preparation:

Operation and implements used	Hours of labor		Acres covered in a 10-hour day
	Man	Horse	
Plowing with 2-bottom gang plow and 5 horses	2	10	5
Plowing with 16-inch sulky plow and 3 horses	3⅓	10	3
Disking with 8-foot disk and 4 horses	½	2	20
Harrowing with 22-foot harrow and 4 horses	⅕	⅘	50

These standards can easily be attained on farms having large-sized implements, large teams, and large fields conveniently located in relation to the farmstead. The plowing requirement is for stubble plowing. It would have to be increased for sod plowing according to the toughness of the sod. The usual depth of plowing in the Windom area, 5 to 6 inches, is assumed in setting these standards.

FALL PLOWING

Approximately two-thirds of all plowing on these farms is done in the fall for the following year's crop. In presenting graphically the seasonal distribution of labor on individual crops, this fall plow-

[7] The farm buildings and yards surrounding them.

ing will not be shown, because it does not occur during the year that the crop is grown. In order that its place in the seasonal labor program may be known, distribution of fall plowing labor by days for an individual farm is shown in Figure 6.

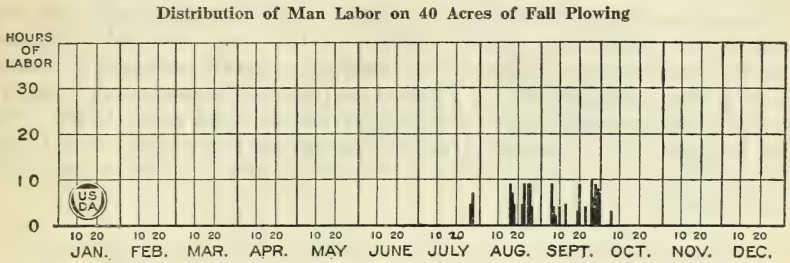

FIG. 6.—A large part of the land is fall plowed for spring crops. Much of this is done after the completion of small grain harvest in August and before corn husking begins in October

Fall plowing is spread over a considerable period of time. It may begin the latter part of July as soon as small grain is stacked or threshed, and last until the ground freezes in November. However, on these farms most of it is usually performed during two distinct periods. One is during the latter part of August after stacking and shock threshing is completed and before silo filling begins. The other is during the latter part of September and the early part of October after silo filling is finished and before corn husking begins.

CORN

All land for corn is plowed. Practically all the small-grain land and grassland is fall plowed for corn. Forty per cent of the corn acreage is spring plowed, but this land was mostly in corn the previous year and not husked in time for fall plowing. Fall plowing is much preferred and is practiced as far as time permits, because it relieves some of the rush of cornland preparation in the spring and makes possible earlier planting. All but about 17 per cent of the cornland, whether spring plowed or fall plowed, is disked in the spring. The fall plowing is usually disked twice and the spring plowing once. Some land is disked three times, but one and one-half times represent the average or usual custom.

All cornland is harrowed before planting. Half of it is harrowed only once, and the balance is covered two, three, or even four times. The average number of harrowings before planting is one and three-quarters. Eighty-five to ninety per cent of all corn is checked in as hill corn. The remaining acreage is drilled in. This is usually planted more thickly than the checked corn and is used largely for silage or planted late and cut for fodder. Four-fifths of the total acreage is harrowed at least once after planting. About 40 per cent of this is harrowed twice. On one-third of the farms blind cultivating is practiced. This practice is usually applied only to the earlier plantings and only 18 per cent of the total acreage is blind cultivated. The most common number of cultivations after the corn is above ground is three. About one-quarter is cultivated four times and a small amount five and six times. A small acreage of the later planted drilled corn is cultivated only twice. Most farmers in this area plan

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to cultivate their checked corn four times, but weather conditions and the press of other work usually prevent the full accomplishment of this on the whole acreage. For the entire acreage the average number of cultivations, including blind cultivation, is three and a half.

During the three years of this study, 73 per cent of all corn was husked from standing stalks. Most of this was husked by hand, although a mechanical picker was used on a small acreage. Eleven per cent was "hogged off." This latter practice is increasing rapidly. Nearly twice as much corn was hogged off in 1922 as in 1920. One farm hogged off 26 acres. Half of the farms have silos, and 11 per cent of all corn is siloed. The remaining 5 per cent is cut and fed in the bundle.

LABOR REQUIREMENTS FOR CORN HUSKED FROM STANDING STALKS

The labor requirements for corn husked from the standing stalk are presented in Tables 6 and 7. The acreage of corn given in these tables are the total for the farm and include silage corn, fodder corn, and corn hogged off, as well as that husked from standing stalks. Causes for variations in the time spent on seed-bed preparation have already been discussed. In these tables, the number of hours is the total for each operation whether it was performed once or repeated, and does not represent a once-over figure as did those in Table 5. Where the operation is repeated, the number of times is indicated in the column following the hour figure.

TABLE 6.—*Man-labor requirements per acre, by operations, for corn husked from standing stalk, 1921*

Farm No.[1]	Acres[2] per farm	Yield per acre	Plowing	Disking		Harrowing		Planting	Cultivating		Husking	Total
				Total	Times over	Total	Times over		Total	Times over		
		Bushels	*Hours*	*Hours*		*Hours*		*Hours*	*Hours*		*Hours*	*Hours*
10	53	34	[3] 1.98	0.73	1.55	0.69	2.75	0.91	2.70	2.62	5.64	12.65
3	92	38	1.81	.52	1.28	.47	2.49	.60	3.70	3.16	5.82	12.92
7	61	29	3.03	.50	1.00	.53	2.41	.59	3.72	3.00	4.55	12.92
18	29	40	[3] 3.25	1.50	2.00	.58	2.65	.80	4.14	2.67	4.28	14.55
2	69	31	2.54	.41	.70	.88	2.93	.71	4.74	3.00	5.85	15.13
13	55	56	[4] 2.18	[3] .58	1.67	.58	2.22	.73	3.99	3.00	7.73	15.79
6	72	55	2.31	.45	.80	.65	2.50	.82	3.99	2.89	7.78	16.00
19	44	48	3.01	.76	1.33	.61	2.12	.81	3.85	2.81	7.24	16.28
20	30	55	3.66	.85	1.88	.85	3.26	.73	4.12	2.80	7.08	17.29
11	56	53	3.01	.23	.48	1.23	3.00	1.06	4.69	2.91	8.12	18.34
1	96	50	2.24	.69	1.65	.76	3.17	.61	3.24	2.28	11.46	19.00
5	83	52	3.23	1.00	2.00	.72	3.11	.73	4.11	2.67	9.93	19.72
22	21	41	2.30	1.20	1.41	1.80	3.46	1.62	5.25	2.84	7.59	19.76
16	42	39	3.23	.31	.56	1.34	3.72	.91	4.91	3.34	9.97	20.67
9	62	41	3.30	1.26	2.48	.39	1.87	.62	6.20	4.84	9.18	20.95
8	40	60	3.28	1.06	1.60	.72	2.75	.81	6.64	4.00	8.72	21.23
4	85	45	2.35	.66	1.65	.72	2.88	.71	4.47	3.19	12.72	21.63
17	32	53	4.34	1.38	2.13	.81	2.45	.72	4.80	4.00	9.77	21.82
12	40	51	3.35	1.86	3.00	.35	1.00	1.00	8.85	5.00	7.85	23.26
15	55	44	3.47	.88	1.31	1.30	2.77	.85	5.44	3.11	11.84	23.78
14	52	58	3.33	.90	1.96	1.23	3.41	.86	6.52	4.00	14.82	27.66
Average 18 farms:												
1921 [5]	57	46	2.87	.95	1.82	.79	2.74	.77	4.72	3.23	8.77	18.87
1920 [5]	57	38	2.70	.92	1.54	.94	3.02	.84	5.33	3.60	7.96	18.69
1922 [5]	66	33	3.02	.81	1.56	.75	2.59	.74	5.19	3.79	6.66	17.17

[1] Farms are arrayed in order of total man-labor requirements beginning with the lowest.
[2] Total corn acreage on farm.
[3] Tractor used for part of this operation.
[4] Tractor used for all plowing.
[5] Data from farms using tractor omitted in computing these averages.

TABLE 7.—*Horse-labor requirements per acre, by operations, for corn husked from standing stalk, 1921*

Farm No.[1]	Acres[2] per farm	Yield per acre	Plowing	Disking		Harrowing		Planting	Cultivating		Husking	Total
				Total	Times over	Total	Times over		Total	Times over		
		Bushels	*Hours*	*Hours*		*Hours*		*Hours*	*Hours*		*Hours*	*Hours*
10	53	34	[3] 8.41	3.64	1.55	3.44	2.75	1.82	10.43	2.62	12.98	40.72
3	92	38	9.60	2.10	1.28	1.89	2.49	1.20	7.40	3.16	9.37	31.56
7	61	29	12.56	2.64	1.00	2.24	2.41	1.18	7.44	3.00	9.10	35.16
18	29	40	[4] 8.56	6.48	2.00	2.33	2.65	1.60	8.28	2.67	12.90	40.15
2	69	31	10.30	1.62	.70	3.52	2.93	1.42	9.48	3.00	11.55	37.89
13	55	56		[5] 5.38	1.67	2.35	2.22	1.49	7.98	3.00	15.61	27.81
6	72	55	9.29	1.79	.80	2.48	2.50	1.61	8.12	2.89	15.14	38.43
19	44	48	11.88	3.60	1.33	2.35	2.12	1.62	7.90	2.81	14.34	41.69
20	30	55	10.98	3.38	1.88	3.06	3.26	1.46	8.23	2.80	13.38	40.49
11	56	53	9.64	.71	.48	3.57	3.00	2.12	9.57	2.91	14.47	40.08
1	96	50	8.85	2.77	1.65	2.44	3.17	1.22	6.48	2.28	12.25	34.01
5	83	52	10.94	4.00	2.00	2.55	3.11	1.35	8.22	2.67	13.35	40.41
22	21	41	9.20	4.48	1.41	7.20	3.46	3.24	10.51	2.84	15.18	49.81
16	42	39	10.66	.94	.56	4.91	3.72	1.82	9.82	3.34	19.37	47.52
9	62	41	13.92	6.18	2.48	1.57	1.87	1.24	12.58	4.84	18.20	53.69
8	40	60	13.16	4.22	1.60	2.39	2.75	1.62	13.28	4.00	16.13	50.80
4	85	45	10.60	2.56	1.65	2.88	2.88	1.42	8.93	3.19	21.67	48.06
17	32	53	14.29	5.24	2.13	3.18	2.45	1.44	11.12	4.00	19.54	54.81
12	40	51	15.43	6.90	3.00	1.23	1.00	2.00	17.70	5.00	13.49	56.75
15	55	44	10.25	3.51	1.31	3.55	2.77	1.70	10.88	3.11	11.67	41.56
14	52	58	15.73	4.51	1.96	5.05	3.41	1.72	13.04	4.00	17.65	57.70
Average 18 farms:												
1921[6]	57	46	11.20	3.91	1.82	2.88	2.74	1.14	9.53	3.23	14.07	42.73
1920[6]	57	38	10.91	3.76	1.54	3.47	3.02	1.67	10.69	3.60	13.76	44.26
1922[6]	66	33	11.54	3.56	1.56	2.90	2.59	1.49	10.57	3.79	11.90	41.96

[1] Farms are arrayed in order of total man-labor requirements beginning with the lowest
[2] Total corn acreage on farm.
[3] In addition to the horse-hours, 0.12 tractor-hour per acre was used for plowing.
[4] In addition to the horse-hours, 0.66 tractor-hour per acre was used for plowing.
[5] In addition to the horse-hours, 2.18 tractor-hours per acre were used for plowing and 0.54 tractor-hour for disking.
[6] Data from farms using tractors omitted in computing these averages.

CAUSES FOR VARIATIONS IN LABOR REQUIREMENTS FOR CORN HUSKED FROM STANDING STALK

All corn was planted with a 2-row horse-drawn planter. The only variation in the planting operation due to equipment was the difference in the time required for drilling, as compared with checking corn. The time spent in stretching the check-rower wire increased the time required per acre for planting.

On farm 10, which has the lowest man-labor requirements per acre for one cultivation, a 2-row cultivator with four horses was used almost exclusively. On farm 17 the man-labor requirements were also cut down by the use of a 2-row cultivator. The 2-row machine, however, increased the horse-labor requirements somewhat. On all other farms single-row 2-horse cultivators were used.

The use of a mechanical corn picker resulted in low man-labor requirements for husking on farm 18. Some saving in horse labor occurred. Low labor requirements for husking on farm 10 were due in part to the use of a mechanical picker on a portion of the acreage. Man-labor is saved in husking by the use of only one man with a team. On farms 1 and 15 two men worked with one team in husking, and although the horse-labor requirements per acre were low the man-labor requirements per acre were among the highest in the group. (Tables 6 and 7.)

Labor requirements for cultivation are lowest on large, well-shaped fields. On farms 3, 7, and 13, which used the least number of man and horse hours for cultivating 1 acre one time over with a 1-row cultivator, the average size of field was 26 acres and the average length 92 rods. On farms 8, 15, and 22, with high labor requirements, the average size of field was 8¼ acres and the average length 52 rods. The labor requirements on farm 15 are further increased by the distance of the fields from the farmstead. More than half of the cornland was over a mile from the farmstead.

On Farm 1, although most of the operations were performed with less labor than on the majority of the farms, the man-labor requirement per acre for husking was one of the highest. This work was performed by members of the family and included woman and child labor, whereas on most farms the husking was done by experienced man labor.

Except for husking, there was no marked relation between yield and labor requirements. In general, the labor requirements for husking increased with increased yields. This tendency is especially evident from a comparison of the average requirements for the three years.

The effect on labor requirements of repeating an operation is quite apparent in case of cultivating. On farm 9 the man-labor required for one cultivation was one of the lowest in the group, but the large number of cultivations, 4.84, brings the total requirement for cultivating among the highest. The same increase is apparent in a less degree in harrowing and disking.

LABOR REQUIREMENTS FOR SILAGE CORN

The labor requirements for silage corn are presented in Tables 8 and 9. Since the operations on the corn crop prior to harvesting are the same regardless of how it is to be harvested, this labor is included as one item in these tables. This is taken from Tables 6 and 7 and includes all labor prior to husking. It has already been considered in the discussion of those tables. The item of "filling silo" includes all labor involved in hauling the corn to the silo, filling the silo, packing the silage, and any incidental operations.

TABLE 8.—*Man-labor requirements per acre by operations for silage corn, 1921*

Farm No.	Acres per farm	Yield	Total before cutting	Cutting	Filling silo	Total
		Tons	*Hours*	*Hours*	*Hours*	*Hours*
16	9	6.1	10.70	0.98	8.00	19.68
7	7	8.9	8.37	1.08	12.77	22.22
4	11	7.5	8.91	1.63	13.68	24.22
9	8	7.5	11.77	1.61	12.50	25.88
11	11	8.0	10.22	2.06	14.29	26.57
14	7	9.4	12.84	2.25	12.76	27.85
18	9	9.0	10.27	2.24	16.54	29.05
15	9	8.5	11.94	2.79	14.75	29.48
20	8	8.8	10.21	1.76	18.53	30.50
8	8	9.1	12.51	3.72	15.32	31.55
Average:						
10 farms, 1921	[1] 9	8.2	10.70	2.00	13.92	26.62
10 farms, 1920	12	4.6	10.91	1.63	9.29	21.83
12 farms, 1922	13	6.2	11.23	1.97	10.45	23.65

[1] Farms are arrayed in order of total man-labor requirements beginning with the lowest.

TABLE 9.—*Horse-labor requirements per acre, by operations for silage corn, 1921*

Farm No.[1]	Acres per farm	Yield	Total before cutting	Cutting	Filling silo	Total
		Tons	*Hours*	*Hours*	*Hours*	*Hours*
16	9	6.1	28.15	2.53	14.00	44.68
7	7	8.9	26.06	3.24	12.31	41.61
4	11	7.5	26.39	4.89	15.79	47.07
9	8	7.5	35.49	4.83	12.50	52.82
11	11	8.0	25.61	6.18	13.67	45.46
14	7	9.4	40.05	6.75	12.76	59.56
18	9	9.0	27.25	6.08	12.17	45.50
15	9	8.5	29.89	8.37	18.25	56.51
20	8	8.8	27.11	3.52	23.00	53.63
8	8	9.1	34.67	7.06	14.44	56.17
Average:						
10 farms, 1921	9	8.2	29.67	5.39	14.90	49.96
10 farms, 1920	12	4.6	29.80	4.77	8.94	43.51
12 farms, 1922	13	6.2	30.78	5.39	12.67	48.84

[1] Farms are arrayed in order of total man-labor requirements beginning with the lowest.

CAUSES FOR VARIATIONS IN LABOR REQUIREMENTS FOR SILAGE CORN

The lowest labor requirements for filling were found on farm 16, which also had the lowest yield. The effect of increased yields in increased labor requirements is to be noted in comparing the average requirements for the three years.

The largest number of hours per acre for cutting were expended on farm 8, owing to the fact that an extra team and an extra driver were used on the binder for part of this cutting.

LABOR REQUIREMENTS FOR FODDER CORN

The labor requirements for fodder corn are shown in Tables 10 and 11. This classification includes all corn cut and fed in the bundle, whether corn drilled in thickly for fodder only or checked corn with mature ears. It is largely the former. Only the harvesting operations are shown. The labor of growing the crop has been taken from Tables 6 and 7 as in the case of silage corn.

TABLE 10.—*Man-labor requirements per acre, by operation for fodder corn, 1921*

Farm No.[1]	Acres per farm	Yield	Total before harvest	Cutting	Shocking	Total
		Tons	*Hours*	*Hours*	*Hours*	*Hours*
3	22	1.5	7.10	1.58	1.94	10.62
1	17	2.1	7.54	1.63	2.38	11.55
20	1	2.3	10.21	1.76		11.97
13	4	3.3	8.06	1.81	3.23	13.10
6	8	2.0	8.22	1.71	3.60	13.53
5	10	1.3	9.79	1.45	4.10	15.34
17	2	2.6	12.05	1.68	1.89	15.62
21	8	1.4	11.14	1.88	2.66	15.68
11	3	1.2	10.22	2.06	4.00	16.28
9	1	4.0	11.77	1.61	3.00	16.38
22	5	.4	12.17	2.48	1.76	16.41
8	1	4.2	12.51	3.72	3.09	19.32
12	4	4.0	15.41	2.50	7.38	25.29
Average:						
13 farms, 1921	7	1.9	9.11	1.77	2.90	13.78
7 farms, 1920	8	2.1	10.62	1.50	3.17	15.29
8 farms, 1922	8	1.7	9.78	2.03	2.50	14.31

[1] Farms are arrayed in order of total man-labor requirements begin ning with the lowest.

TABLE 11.—*Horse-labor requirements per acre, by operation for fodder corn, 1921*

Farm No.[1]	Acres per farm	Yield	Total prior to harvest	Cutting	Total
		Tons	*Hours*	*Hours*	*Hours*
3	22	1.5	22.19	4.47	26.66
1	17	2.1	21.76	4.89	26.65
20	1	2.3	27.11	3.52	30.63
13	4	3.3	12.20	5.43	17.63
6	8	2.0	23.29	5.73	29.02
5	10	1.3	27.06	4.90	31.96
17	2	2.6	35.27	5.04	40.31
21	8	1.4	28.03	5.64	33.67
11	3	1.2	25.61	6.18	31.79
9	1	4.0	35.49	4.83	40.32
22	5	0.4	34.63	7.44	42.07
8	14	4.2	34.67	7.06	41.73
12	4	4.0	43.26	7.50	50.76
Average:					
13 farms, 1921	7	1.9	25.43	5.28	30.71
7 farms, 1920	8	2.1	29.05	4.62	33.67
8 farms, 1922	8	1.7	26.86	6.12	32.98

[1] Farms are arranged in order of total man-labor requirements beginning with the lowest.

CAUSES FOR VARIATIONS IN LABOR REQUIREMENTS FOR FODDER CORN

The higher yielding fields require more labor for harvesting. This is especially true in case of shocking.

Farm 8 has high labor requirements for cutting for the reason mentioned in the silage discussion.

On farms 5 and 12, having the highest labor requirements for shocking, the fields shocked were from one-half to 1½ miles from the farmstead. Rain interference increased the number of trips to these fields by a considerable amount, thus emphasizing this handicap.

MATERIAL REQUIREMENTS FOR CORN

The average quantity of seed per acre for checked corn on all farms for the three years was 8.7 pounds. It varied from 7.2 pounds to 10.5 pounds. This checked corn was spaced 3 feet 6 inches or 3 feet 8 inches, and three or four kernels were planted per hill. The average rate of seeding for drilled corn was 14.7 pounds, with a range from 8.9 pounds to 24.9 pounds. This wide range was due to the fact that some corn was planted thinly so that full-sized ears would be formed, whereas most of it was planted thickly so that there would be no mature ears. The average quantity of twine used per acre was 3.6 pounds. The least quantity was 1.5 pounds and the largest 6.4 pounds. The range was largely due to differences in yield. Twine requirements for drilled corn are usually much higher than for checked corn, because the drilled corn is planted more thickly.

STANDARD REQUIREMENTS PER ACRE FOR CORN PRODUCTION IN SOUTHWESTERN MINNESOTA

The standard requirements shown in Table 12 are suggested for corn production. As has been stated, they represent the accomplishment of those farmers who handle their labor most efficiently as measured by their ability to perform the various operations with the least hours of labor. These standard requirements furnish a standard of attainment for all farmers to use as their guide. The seed require-

ments are based on usual seeding rates in the community. The twine requirements are based on twine consumption in cutting a normal crop.

TABLE 12.—*Standard requirements for corn production*

Operation and implement used	Hours of labor		Acres covered in 10-hour day
	Man	Horse	
Plowing, gang plow and 5 horses	2	10	5
Plowing, sulky plow and 3 horses	3⅓	10	3
Disking, 8-foot disk and 4 horses	½	2	20
Harrowing, 22-foot harrow and 4 horses	⅕	⅘	50
Planting	⅔	1⅔	15
Cultivating, 1-row cultivator	1⅓	2⅔	7½
Husking, 1 man with team (45 bushel yield)	7½	15	1⅓
Cutting, 3-horse team	1⅔	5	6
Filling silo, 8-ton yield	11	12½	1/10
Shocking, 2-ton yield	2½		4

Seed for checked corn, 8 pounds.
Seed for drilled corn (silage or fodder), 15 pounds.
Twine, 3½ pounds.

DISTRIBUTION OF LABOR ON CORN

The dates between which the different operations on the corn crop are commonly performed and the number of work days usually available during the period are shown in Table 13. These dates are subject to seasonal fluctuations, but their general sequence is rather uniform. The days available are computed by subtracting from the total days in the period all Sundays and holidays included, and also an estimated number of days on which rain would interfere with the operation. This estimate is based on 10 years' precipitation data for the area interpreted in the light of actual rain interference with the various operations during the three years of the study.

TABLE 13.—*Dates and work days available for performing different operations on the corn crop*

Operation	Dates	Work days available	Operation	Dates	Work days available
Spring plowing	Apr. 26 to May 25	21	Cultivating	June 1 to July 10	28
Disking	May 1 to May 25	18	Cutting	Sept. 1 to Sept. 30	22
Harrowing	May 5 to June 1	17	Filling silo	Sept. 1 to Sept. 15	10
Planting	May 10 to May 28	12	Husking	Oct. 10 to Dec. 10	47

These figures do not include the extreme ranges of dates for any operation. They cover only the period during which the operation is most commonly performed. For example, corn was planted as early as May 5 and as late as the latter part of June, but little is planted before May 10 or later than May 28. In fact, most of the corn for grain is planted before May 28, and the latter part of the period is devoted largely to drilled corn for silage and fodder. The dates suggested are ordinarily the most satisfactory time for performing the several operations and can safely be used in planning the farm labor program.

Figure 7 shows the daily distribution of man labor on 57 acres of corn. Of this, 34 acres were husked standing, 11 hogged off, 11 siloed, and 1 acre cut and fed in the bundle. Five acres of the

silage corn was drilled and the remainder of the corn checked. The peak labor demand occurred during the silo filling in September. Most of the land was fall plowed and hence the work did not start so early in the spring as where there is considerable spring plowing to do. The husking labor was concentrated in a somewhat shorter period than is usually the case. Otherwise the labor distribution is quite characteristic for the area.

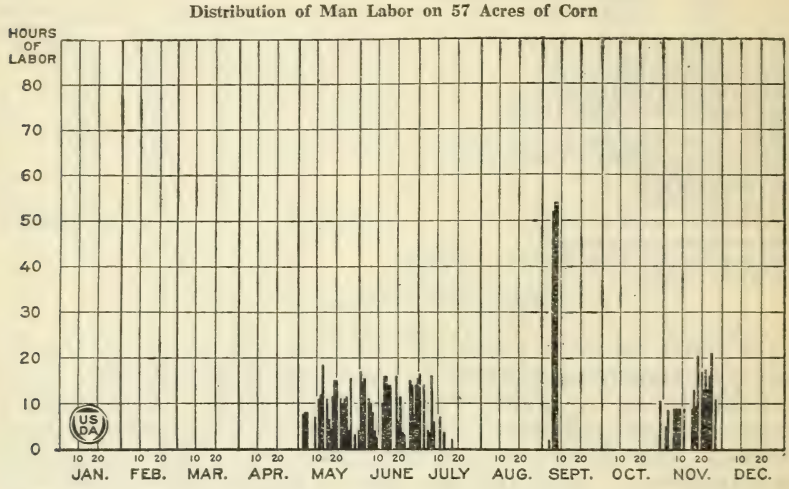

FIG. 7.—Corn cultivation can usually be finished early in July before the oats harvest begins. Silo filling takes large crews of men and horses for a few days

OATS

During the three years of this study only 25 per cent of the oat land was plowed; the remainder was disked into cornland. This practice has increased with the increased use of cornland for oats. In 1920, half of the oat land was plowed, but in 1922 only 5 per cent. The plowing was practically all done in the fall. All but 3½ per cent of the oat land was disked at least once and most of it was disked two or more times. The average for all farms was one and three-fourths diskings. Where an end-gate seeder is used the oats are often seeded first and then the land is disked. Sometimes the land is disked before seeding and again after. It is often disked after seeding where an ordinary broadcast seeder is used, but seldom where a drill is used. Only one-third of the oat land was harrowed before seeding, but four-fifths was harrowed after seeding and 5 per cent was not harrowed at all. A little over one-half was harrowed once and the remainder two or more times. The average number of harrowings was one and four-tenths.

Sixty-three per cent of the oat acreage was planted with a drill. A disk drill was generally used. Twenty-three per cent was seeded with a broadcast seeder and 14 per cent with an end-gate seeder. The oat crop was cut with a binder and shocked. A small amount was fed in the bundle but most of the crop was threshed. In the past three years there has been a rapid transition from stack threshing to shock threshing. In 1920, 33½ per cent of the oat acreage was shock threshed; in 1921, 63½ per cent; and in 1922, 70 per cent.

LABOR REQUIREMENTS FOR OATS PRODUCTION

The labor requirements for oats are presented in Tables 14 and 15. The total hours for each operation are shown and in case an operation is repeated, the number of times is indicated. Since shock threshing is the common practice, the average total labor requirements are on the basis of shock rather than stack threshing. The average for the latter operation is given so that a stack-threshing total can be computed.

TABLE 14.—*Man-labor requirements per acre, by operations for oats, 1921*

Farm No.[1]	Acres per farm	Yield	Plowing		Disking		Harrowing	
			Total	Times over	Total	Times over	Total	Times over
		Bushels	*Hours*		*Hours*		*Hours*	
3	81	33			0.75	1.54	0.22	1.21
2	93	29	1.25	0.59	.40	.81	.44	1.98
17	41	29			.82	1.16	.37	1.16
1	77	34	.14	.065	1.17	2.30	.26	1.00
10	32	29	.13	.07	1.10	2.50	.34	2.00
6	50	41			1.02	2.00	.26	1.00
9	45	31	.14	.04	1.26	2.00	.33	1.38
7	47	32	1.53	.46	.75	1.54	.28	1.00
5	81	31			1.04	2.00	.25	1.00
15	32	36			1.16	2.00	.19	.53
4	54	45			1.16	2.00	.15	.72
20	25	32			1.26	2.00	.31	1.00
19	24	32	.10	.03	1.12	2.00	.31	1.00
18	41	35	1.35	.43	.67	1.39	.41	2.30
14	41	26			1.46	2.00	.39	1.31
16	20	31	.52	.17	1.52	2.50	.96	3.00
13	27	39	[2] 2.18	[2] 1.00	.56	2.00		
11	34	37	2.07	.70	.31	.60	.56	1.70
21	8	28	1.57	.65	.60	1.00	.24	1.00
12	58	37	1.41	.50	.97	1.68	.63	2.32
22	15	24	.71	.31	1.78	2.92	.36	1.46
8	53	40	1.70	.61	1.06	2.00	.26	1.00
Average:								
21 farms, 1921 [3]	45	33	.57	.21	.96	1.75	.34	1.37
16 farms, 1920 [3]	40	37	1.25	.48	.75	1.23	.46	1.64
18 farms, 1922 [3]	48	41	.13	.04	1.00	1.92	.32	1.12

Farm No.[1]	Seeding	Cutting	Shocking	Stacking	Stack threshing	Shock threshing	Total
	Hours	*Hours*	*Hours*	*Hours*	*Hours*	*Hours*	*Hours*
3	0.48	0.74	0.88			2.25	5.32
2	.54	.74	.62			1.79	5.78
17	.53	.91	.80			2.40	5.83
1	.51	.80	1.12			2.44	6.44
10	.52	.94	.85			2.97	6.85
6	.48	.91	1.32			2.89	6.88
9	.45	.55	1.32			3.01	7.06
7	.20	.84	1.31			2.17	7.08
5	.30	.75	1.28	2.74	0.73		7.09
15	.50	.99	1.86			2.58	7.28
4	.61	.88	.97			3.54	7.31
20	.59	.87	1.02	2.76	.81		7.62
19	.78	1.26	.93	2.14	.99		7.63
18	.45	.96	1.06			2.94	7.84
14	.24	1.00	1.91			3.96	8.96
16	1.12	.92	.97	2.75	.51		9.27
13	.47	1.01	.86	3.23	.98		9.29
11	.54	.79	2.08			2.99	9.34
21	.54	1.21	.97	2.72	1.69		9.54
12	.47	.90	1.12	2.82	1.32		9.64
22	.47	1.08	1.42	2.83	1.08		9.73
8	.50	.96	1.08	3.36	1.64		10.56
Average:							
21 farms, 1921 [3]	.48	.86	1.14	2.83	1.08	2.65	[4] 7.00
16 farms, 1920 [3]	.58	.78	1.07	2.54	1.10	2.67	[4] 7.56
18 farms, 1922 [3]	.48	.77	.98	2.87	1.06	2.23	[4] 5.91

[1] Farms are arrayed in order of total man-labor requirement, beginning with the lowest.
[2] Plowed and disked with tractor.
[3] Farms using tractor omitted in computing these averages.
[4] Total is for shock threshing. Total hours per acre for stacked oats in 1921, 8.26.

TABLE 15.—*Horse-labor requirements per acre, by operations for oats, 1921*

Farm No.[1]	Acres per farm	Yield	Plowing		Disking		Harrowing	
			Total	Times over	Total	Times over	Total	Times over
		Bushels	*Hours*		*Hours*		*Hours*	
3	81	33			3.02	1.54	0.87	1.21
2	93	28	5.69	0.59	1.42	.81	1.72	1.98
17	41	29			3.29	1.16	1.48	1.16
1	77	34	.55	.065	4.76	2.30	1.06	1.00
10	32	29	.66	.07	4.13	2.50	1.70	2.00
6	50	41			4.08	2.00	1.04	1.00
9	45	31	.41	.04	5.04	2.00	1.06	1.38
7	47	32	4.77	.46	3.02	1.54	1.12	1.00
5	81	31			4.20	2.00	.86	1.00
15	32	36			4.64	2.00	.66	.53
4	54	45			4.48	2.00	.60	.72
20	25	32			3.90	2.00	.90	1.00
19	24	32	.31	.03	5.64	2.00	1.16	1.00
18	41	35	4.88	.43	3.04	1.39	1.63	2.30
14	41	26			7.28	2.00	1.56	1.31
16	20	31	[2] 1.76	.17	[3] 5.35	2.50	3.84	3.00
13	27	39		1.00		2.00		
11	34	37	6.62	.70	1.25	.60	1.82	1.70
21	8	28	6.26	.65	1.81	1.00	.73	1.00
12	58	37	5.96	.50	3.90	1.68	1.93	2.32
22	15	24	2.83	.31	6.95	2.92	1.46	1.46
8	53	40	5.59	.61	4.06	2.00	1.04	1.00
Average:								
21 farms, 1921 [4]	45	33	2.15	.21	3.87	1.75	1.29	1.37
16 farms, 1920 [4]	40	37	5.03	.48	2.96	1.23	1.67	1.64
18 farms, 1922 [4]	48	41	.40	.04	3.97	1.92	1.20	1.12

Farm No.[1]	Seeding	Cutting	Stacking	Stack threshing	Shock threshing	Total
	Hours	*Hours*	*Hours*	*Hours*	*Hours*	*Hours*
3	0.96	2.96			3.95	11.76
2	1.98	2.92			2.66	16.39
17	2.06	3.64			3.20	13.67
1	2.04	3.20			4.36	15.97
10	1.05	3.76			3.70	15.00
6	1.92	3.22			5.02	15.28
9	.90	2.20			5.10	14.71
7	.40	3.36			3.98	16.65
5	.60	3.03	3.53	1.09		13.31
15	2.00	3.96			4.91	16.17
4	1.83	2.64			5.59	15.14
20	1.61	3.48	2.76	.97		13.62
19	3.11	5.06	2.76	1.49		19.53
18	1.83	3.86			4.87	20.11
14	.69	3.57			5.09	18.19
16	2.65	3.68	3.67	.51		21.46
13	1.88	3.03	3.23	1.20		9.34
11	2.16	3.16			4.93	19.94
21	2.18	3.63	2.90	1.93		19.44
12	1.88	3.60	3.62	2.39		23.28
22	.94	4.32	3.78	1.08		21.38
8	2.00	3.68	3.75	1.95		22.07
Average:						
21 farms, 1921 [4]	1.57	3.31	3.46	1.52	4.27	[5] 16.46
16 farms, 1920 [4]	1.81	3.08	3.04	1.10	4.98	[5] 19.53
18 farms, 1922 [4]	1.42	3.01	3.47	1.20	3.36	[5] 13.36

[1] Farms are arrayed in order of total man-labor requirements beginning with the lowest.
[2] 2.18 tractor hours per acre were used for plowing.
[3] 0.56 tractor hour per acre was used for disking.
[4] Farms using tractors omitted in computing these averages.
[5] Total is for shock threshing. Total hours per acre for stacked oats in 1921, 17.17.

CAUSES FOR VARIATIONS IN LABOR REQUIREMENTS FOR OATS

End-gate seeders were used on farms 5, 7, and 14, and the labor requirements for seeding were much lower than on any other farm. The man-labor requirement where an ordinary broadcast seeder was used was about the same as for a drill; but the horse-labor requirement was only about half as large, since only two horses were used on the seeders and four was the usual number on a drill. On farms 3, 9, 10 and 22, broadcast seeders were used. On farm 16, a small 2-horse drill was used, so both man and horse labor requirements were high.

On farms 13 and 21 only three horses were used on the binder, whereas four were used on practically all the other farms. The horse-labor requirement on these farms was about the same as the others, but the man-labor requirements were higher. On farm 4 only three horses were used on the binder; but they were much larger horses than were used on any of the other farms, so that the horse-labor requirement was one of the lowest and man labor only about the average.

The labor requirements for cutting were highest on farms 15, 19, and 22, and lowest on farms 2, 3, and 9. The average-size field of oats on the first group of farms was 14 acres and the total acreage per farm 24. The same acreages for the second group of farms were 20 and 73 respectively. One-third of the oat acreage on farms 14 and 15 was over a mile distant from the farmstead. This was reflected in high labor requirements for cutting and shocking. It resulted also in high labor requirements for threshing on farm 14.

The high labor requirements for shocking on farms 11 and 14 and for stacking on farm 8 were due in part to the use of family labor. On both farms boys were used in these operations.

On farms 8 and 13, having the highest labor requirements for stacking, the yield per acre was 20 per cent higher than the average for all farms where oats were stacked. The highest yield was obtained on farm 4. The horse labor for shock threshing was highest on this farm and the man labor next to the highest.

The data show that the man-labor requirements for stacking and stack threshing were about 50 per cent higher than for shock threshing. There was also a small increase in horse-labor requirements.

The total labor requirements per acre were lowest on those farms where little or none of the acreage was plowed. The highest labor requirements for disking or harrowing were found on those farms where these operations were repeated the greatest number of times. Although the man and horse labor requirement for harrowing once on farm 18 was the lowest in the group, the fact that the oat land was harrowed 2.3 times brings the total requirement up above the average. On farm 1, a low once-over requirement for disking was brought up above the average by repeating the operation 2.3 times.

MATERIAL REQUIREMENTS FOR OATS

The average quantity of oats sown per acre on all farms for the three years was 3.2 bushels. The maximum rate of seeding was 4.7 bushels, and the minimum 2.5 bushels. The average quantity of seed sown on farms using drills was 3.1 bushels; on farms using broadcast seeders, 3.4 bushels; and on farms using end-gate seeders, 3.9

bushels. The average quantity of twine used per acre was 2.3 pounds, the maximum 3.4 pounds; and the minimum, 1.2 pounds. The average quantity of twine used with yields below 30 bushels per acre was 2.2 pounds; with yields from 30 to 35 bushels, 2.5 pounds; and with yields over 35 bushels, 2.6 pounds. The usual threshing rate per bushel was 3 cents in 1921 and 1922 and 5 cents in 1920. (Table 16.)

TABLE 16.—*Standard requirements per acre for oats production in southwestern Minnesota*

Operation and implement used	Hours of labor		Acres covered in a 10-hour day
	Man	Horse	
Disking, 8-foot disk and 4 horses	½	2	20
Harrowing, 22-foot harrow and 4 horses	1/5	4/5	50
Seeding, 10-foot drill and 4 horses	½	2	20
Cutting, 8-foot binder and 4 horses	¾	3	13⅓
Shocking	1		10
Shock threshing	2½	4	4

Seed, 3 bushels.
Twine, 2.3 pounds.

These requirements cover the usual operations in oat culture in this area. In case it is desirable to plow for oats, the standard plowing requirements may be obtained from Table 5. If the crop is to be stacked, the shock threshing can be replaced with 2.75 man hours and 3.25 horse hours for stacking, and 1 man hour and 1.25 horse hours for threshing.

DISTRIBUTION OF LABOR ON OATS

Table 17 shows the dates between which the different operations on the oat crop are commonly performed and the usual days available for the operation during the period.

TABLE 17.—*Dates and work days available for different operations on the oat crop*

Operation	Dates	Work days available	Operation	Dates	Work days available
Spring plowing	Apr. 5 to Apr. 22	14	Cutting and shocking	July 18 to July 26	7
Disking	Apr. 10 to Apr. 25	10	Stacking	Aug. 2 to Aug. 15	10
Harrowing	Apr. 12 to Apr. 28	13	Stack threshing	Aug. 25 to Sept. 30	27
Seeding	Apr. 12 to Apr. 25	10	Shock threshing	Aug. 1 to Aug. 15	11

Work on the oat crop starts as soon in the spring as the ground is thawed and dry enough to work. In fact, it is the first crop sown in the spring. Therefore, the time of seed-bed preparation and seeding operations is determined largely by seasonal weather conditions. In case of a late spring, the seed-bed preparation is rushed and the number of harrowings and diskings reduced in order that the work on the corn crop be not delayed too long. As in the case of corn, the dates suggested may be safely used in planning the labor program for the farm.

Figure 8 shows the man-labor distribution by days on 45 acres of oats. All of the labor on the crop is confined to 13 days of seed-bed preparation and seeding in April, 6 days of cutting and shocking in

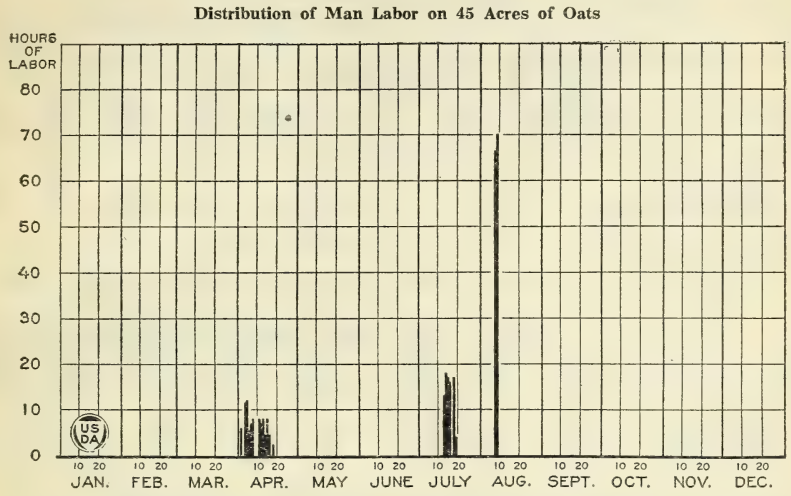

FIG. 8.—Small-grain crops require large amounts of labor during comparatively short periods

July, and 2 days of shock threshing early in August. This is a representative labor distribution for the crop.

BARLEY

Half of the land for barley on these farms is plowed. This plowing is done in the spring. In fact, the barley is often grown on spring plowing, when the plowing is completed too late for oats. The land not plowed is disked, usually at least twice. All barley land is harrowed at least once before seeding and usually once after. The plowed land is harrowed twice before seeding. On all farms included in this study barley was sown with a drill. It was either shock or stack threshed, according to the practice prevailing on the particular farm. This practice has already been discussed for the oat crop.

LABOR REQUIREMENTS FOR BARLEY PRODUCTION

The labor requirements for barley production are presented in Tables 18 and 19. The total hours as given in the yearly averages are computed on the basis of shock threshing. The number of farms growing barley in 1921 was too small to bring out many of the causes for variations in labor requirements by operations. In general, the same factors which caused variations in labor requirements for oats obtain in case of the barley crop.

TABLE 18.—*Man-labor requirements per acre, by operations for barley, 1921*

Farm No.[1]	Acres per farm	Yield	Plowing		Disking		Harrowing	
			Total	Times over	Total	Times over	Total	Times over
		Bushels	*Hours*		*Hours*		*Hours*	
21	8	16			0.60	1.00	0.20	1.00
2	30	21	1.37	0.60	.88	2.00	.48	2.00
6	20	34	.37	.14	1.18	1.96	.42	1.18
1	15	34	1.91	1.00			.72	3.00
Average:								
4 farms, 1921		28	1.06	.49	.75	1.47	.49	1.87
6 farms, 1920		14	.97	.47	.60	.93	.60	2.00
5 farms, 1922		31	1.40	.57	.46	.36	.54	1.74

Farm No.[1]	Seeding	Cutting	Shocking	Stacking	Stack threshing	Shock threshing	Total
	Hours	*Hours*	*Hours*	*Hours*	*Hours*	*Hours*	*Hours*
21	0.59	1.44	0.78	1.83	0.91		6.35
2	.44	1.01	.84			2.39	7.41
6	.66	1.05	1.66			2.86	8.20
1	.51	.82	1.64			3.34	8.94
Average:							
4 farms, 1921	.53	1.03	1.22	1.83	.91	2.75	[2] 7.83
6 farms, 1920	.49	.62	.88	2.45	.77	2.77	[2] 6.93
5 farms, 1922	.50	.66	1.12	2.97	1.02	2.24	[2] 6.92

[1] Farms are arrayed in order of total man-labor requirements, beginning with the lowest.
[2] Total is for shock threshing. Total hours per acre for stack-threshed barley in 1921 was 7.82.

TABLE 19.—*Horse-labor requirements per acre, by operations for barley, 1921*

Farm No.[1]	Acres per farm	Yield	Plowing		Disking		Harrowing	
			Total	Times over	Total	Times over	Total	Times over
		Bushels	*Hours*		*Hours*		*Hours*	
21	8	16			2.31	1.00	0.60	1.00
2	30	21	5.50	0.60	3.52	2.00	1.92	2.00
6	20	34	1.83	.14	4.74	1.96	1.70	1.18
1	15	34	7.64	1.00			2.88	3.00
Average:								
4 farms, 1921		28	4.33	.49	3.00	1.47	1.89	1.87
6 farms, 1920		14	3.71	.47	2.40	.93	2.32	2.00
5 farms, 1922		31	5.73	.57	1.85	.96	2.09	1.74

Farm No.[1]	Seeding	Cutting	Stacking	Stack threshing	Shock threshing	Total
	Hours	*Hours*	*Hours*	*Hours*	*Hours*	*Hours*
21	1.18	5.76	1.83	1.04		12.72
2	1.55	4.04			3.91	20.44
6	2.45	4.20			4.09	19.01
1	2.04	3.28			6.28	22.12
Average:						
4 farms, 1921	1.86	4.11	1.83	1.04	4.51	[2] 19.70
6 farms, 1920	1.62	2.53	2.01	.56	4.70	[2] 17.28
5 farms, 1922	1.71	3.66	3.51	1.51	3.93	[2] 18.97

[1] Farms are arrayed in order of total man-labor requirements, beginning with the lowest.
[2] Total is for shock threshing. Total hours per acre for stack-threshed barley in 1921 was 18.06.

MATERIAL REQUIREMENTS FOR BARLEY

The average rate of seeding barley on these farms was 2 bushels per acre; the range from 1.6 to 2.4 bushels. The average quantity of twine used per acre was 2 pounds and the range 1.6 to 3.7 pounds. The usual threshing rate was 4 cents per bushel in 1921 and 1922 and 6 cents in 1920. The threshing rate for barley is usually 1 cent higher per bushel than the rate for oats. (Table 20.)

TABLE 20.—*Standard requirements per acre for barley production in southwestern Minnesota*

Operation and implement used	Hours of labor		Acres covered in a 10-hour day
	Man	Horse	
Plowing, gang plow and 5 horses	2	10	5
Disking, 8-foot disk and 4 horses	½	2	20
Harrowing, 22-foot harrow and 4 horses	⅕	⅘	50
Seeding, 10-foot drill and 4 horses	½	2	20
Cutting, 8-foot binder and 4 horses	¾	3	13⅓
Shocking	1	-------	10
Shock threshing	2½	4	4

Seed, 2 bushels.
Twine, 2¼ pounds.

If this crop were to be stacked, the shock-threshing hours should be replaced with 2.75 man hours and 3.25 horse hours for stacking, and 1 man hour and 1.25 horse hours for stack threshing.

DISTRIBUTION OF LABOR ON BARLEY

Table 21 shows the dates between which the different operations on the barley crop are commonly performed and the days usually available for the operation during the period:

TABLE 21.—*Dates and work days available for different operations on the barley crop*

Operation	Dates	Days available	Operation	Dates	Days available
Spring plowing	Apr. 20 to Apr. 28	7	Cutting and shocking	July 15 to July 22	7
Disking	Apr. 10 to Apr. 29	16	Stacking	Aug. 1 to Aug. 10	7
Harrowing	Apr. 18 to May 1	11	Stack threshing	Aug. 25 to Sept. 30	22
Seeding	Apr. 21 to Apr. 30	7	Shock threshing	Aug. 1 to Aug. 15	11

On account of the shorter time required to mature the crop, barley can be sown later than oats with equal chance of getting a good crop. The seed-bed preparation and seeding for barley are usually fitted in between those for oats and corn. The barley ordinarily ripens a few days earlier than the oats.

Figure 9 shows the labor distribution by days on a farm having 15 acres of barley. The land was all spring plowed, and harrowed twice before seeding and once after. The crop was shock threshed. This barley was seeded five days later than the oats on the same farm and cut two days earlier.

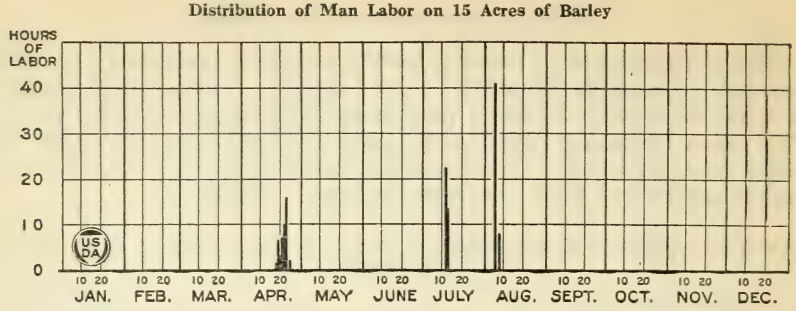

FIG. 9.—Barley and oats require the farmer's time and equipment during practically the same periods of the year

RYE

Rye differs from the other grain crops grown in the Windom area in that it is seeded in the fall. All ground for rye is plowed. Only a small part of it is disked. All is harrowed at least once, some of it twice before planting, and most of it again after seeding. All is sown with a drill. Rye usually ripens a week earlier than oats and several days earlier than barley. It is either shock or stack threshed, according to the usual practice with other small grains on the particular farm.

LABOR REQUIREMENTS FOR RYE PRODUCTION

The labor requirements for rye production are presented in Tables 16 and 17. These data cover the crop sown in 1921 but harvested in 1922. All other crop-requirement data cover the crop planted and the crop harvested in 1921. Since very little rye was grown in either 1920 or 1921, no data covering these years are included.

CAUSES FOR VARIATIONS IN LABOR REQUIREMENTS FOR RYE

The high man-labor requirements for the harvesting and stacking operations on Farm 2 were due to the use of family labor for this work. Much of this work was done by boys. There was more family labor than could be utilized on the farm and no attempt was made to economize its use.

TABLE 22.—*Man-labor requirements per acre, by operations for rye, 1921–1922*

Farm No.[1]	Acres per farm	Yield (bushels per acre)	Plowing		Disking		Harrowing	
			Total	Times over	Total	Times over	Total	Times over
			Hours		*Hours*		*Hours*	
9	29	15	1.69	1.00	------	------	0.53	1.30
10	29	11	[2] 1.77	1.00	------	------	.75	2.63
24	35	20	[2] 1.83	1.00	1.08	2.00	.58	2.00
23	20	22	2.32	1.00	------	------	.60	2.00
21	11	12	1.89	1.00	.45	.59	.54	1.15
6	6	26	1.94	1.00	------	------	.40	2.00
8	15	20	4.04	1.00	.66	1.00	.39	2.00
18	10	44	2.76	1.00	------	------	.59	3.00
2	15	11	2.51	1.00	------	------	.99	3.00
Average, all farms	19	18	[3] 2.39	1.00	.31	.54	.61	2.08

[1] Farms are arrayed in order of total man-labor requirements, beginning with the lowest.
[2] Plowed with tractor.
[3] Only acreage plowed with horses included in this average.

TABLE 22.—*Man-labor requirement per acre, by operations for rye, 1921–1922—Continued.*

Farm No.[1]	Hours per acre						
	Seeding	Cutting	Shocking	Stacking	Stack threshing	Shock threshing	Total
	Hours	*Hours*	*Hours*	*Hours*	*Hours*	*Hours*	*Hours*
9	0.48	0.63	0.87			1.91	6.11
10	.58	.81	.60			1.97	6.48
24	.37	.57	.60			1.57	6.60
23	.53	.84	.84	2.12	1.38		8.63
21	.99	.90	1.26	2.53	1.62		10.18
6	.64	1.28	1.44	2.88	1.60		10.18
8	.66	.82	.99	2.43	1.05		11.04
18	.39	1.28	1.58			5.06	11.66
2	1.32	1.25	2.22	4.17	.72		13.18
Average, all farms	.60	.82	.98	2.78	1.22	2.12	[4] 7.83

[1] Computed on basis of shock threshing.

TABLE 23.—*Horse-labor requirements per acre, by operations for rye, 1921–1922*

Farm No.[1]	Acres	Yield (bushels per acre)	Plowing		Disking		Harrowing	
			Total	Times over	Total	Times over	Total	Times over
			Hours		*Hours*		*Hours*	
9	29	15	8.42	1.00			2.11	1.30
10	29	11	[2]	1.00			2.99	2.63
24	35	20	[3]	1.00	5.00	2.00	2.20	2.00
23	20	22	9.74	1.00			2.32	2.00
21	11	12	5.68	1.00	1.35	.59	1.62	1.16
6	6	26	7.77	1.00			1.60	2.00
8	15	20	12.03	1.00	2.63	1.00	1.38	2.00
18	10	44	11.45	1.00			2.37	3.00
2	15	11	8.28	1.00			3.67	3.00
Average, all farms		18	[4] 9.15	1.00	1.35	.54	2.34	2.08

Farm No.[1]	Hours per acre					
	Seeding	Cutting	Stacking	Stack threshing	Shock threshing	Total
	Hours	*Hours*	*Hours*	*Hours*	*Hours*	*Hours*
9	0.92	2.52			3.34	17.31
10	2.33	3.16			3.34	11.82
24	.74	1.83			3.14	12.91
23	1.61	3.37	2.17	2.28		21.49
21	2.98	3.61	3.43	.72		19.39
6	2.56	5.13	3.85	2.24		23.15
8	2.17	3.29	1.97	.84		24.31
18	1.58	5.13			3.69	24.22
2	3.95	4.98	3.90	.57		25.35
Average, all farms	1.81	3.19	2.87	1.31	3.81	[5] 21.65

[1] Farms are arrayed in order of man-labor requirements, beginning with the lowest.
[2] 1.77 tractor hours per acre for plowing.
[3] 1.83 tractor hours per acre for plowing.
[4] Only acreage plowed with horses included in this average.
[5] Computed on basis of shock threshing.

The high requirements for the harvesting and threshing operations on farm 18 were due to the high yield. This unusual yield was secured on an old lake bed that had just been drained and plowed up for the first time.

MATERIAL REQUIREMENTS PER ACRE FOR RYE

The average rate of seeding rye on these farms was 1.6 bushels per acre. The maximum rate was 2.3 bushels and the minimum 1.4 bushels. The average twine requirement per acre was 1.7 pounds and the range 1 pound to 4 pounds per acre. On account of the small acreage of rye grown in the vicinity, the threshing rate has not become standardized as have the rates for oats and barley. The average rate in 1922 was 6½ cents per bushel and the range 5 to 8 cents. (Table 24.)

TABLE 24.—*Standard requirements per acre for rye production in southwestern Minnesota*

Operation and implement used	Hours of labor		Acres covered in a 10-hour day
	Man	Horse	
Plowing, gang plow and 5 horses	2	10	5
Harrowing, 22-foot harrow and 4 horses	1/5	4/5	50
Seeding, 10-foot drill and 4 horses	½	2	20
Cutting, 8-foot binder and 4 horses	¾	3	13⅓
Shocking	1		10
Shock threshing	2¼	3½	4½

Seed, 1¾ bushels.
Twine, 1¾ pounds.

These requirements can be adjusted for stack threshing by substituting for the shock-threshing hours 2.75 man hours and 3.25 horse hours for stacking, and 1 man hour and 1.25 horse hours for threshing.

DISTRIBUTION OF LABOR ON RYE

Table 25 shows the dates between which the different operations on the rye crop are commonly performed and the number of days available for the operation during the period.

TABLE 25.—*Dates and work days available for different operations on the rye crop*

Operation	Dates	Days available	Operation	Dates	Days available
Plowing	Aug. 20 to Sept. 20	25	Stacking	July 28 to Aug. 10	10
Harrowing	Sept. 14 to Sept. 30	13	Stack threshing	Aug. 25 to Sept. 30	27
Seeding	Sept. 15 to Sept. 28	11	Shock threshing	Aug. 1 to Aug. 15	11
Cutting and shocking	July 10 to July 18	7			

Figure 10 shows the distribution of man labor on a field of 29 acres of rye. This crop was shock threshed. There is a much longer period available for the seed-bed preparation for rye than for the spring-sown grain crops. The seeding may also be spread over a somewhat longer period. The range of seeding dates on these farms was from September 8 to October 10. The earlier seedings are less likely to winterkill and most farmers plan to get their rye sown by September 25. The harvesting operations on rye are early enough to avoid competition with the spring-sown grains, but may conflict seriously with haying operations and the last cultivation of corn.

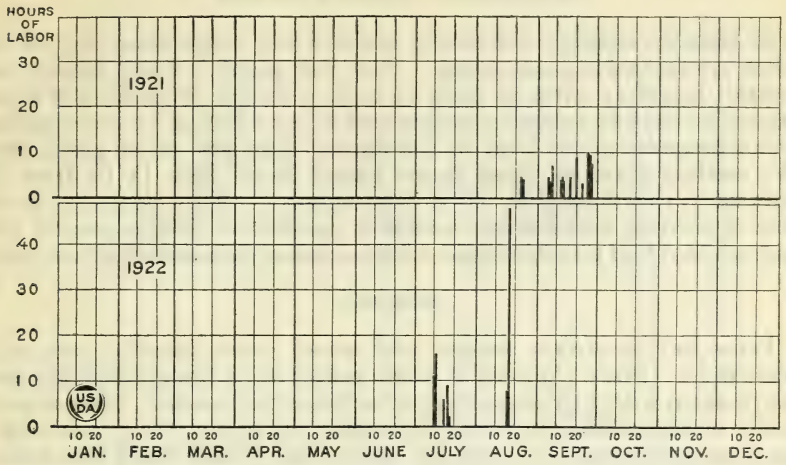

FIG. 10.—Rye is fall sown and is harvested earlier than oats or barley. The rye harvest may interfere with haying or the last cultivation of corn

FLAX

Land is always plowed for flax. This plowing is usually done in the spring. Since flax is usually grown on sod land, it is ordinarily disked at least twice and often three times. It is harrowed once before seeding and sometimes again after seeding. Flax is usually cut with a binder, although in 1920 one farmer in this study cut his with a mower, raked it, and threshed it from the windrows. Shock threshing is the usual practice.

LABOR AND MATERIAL REQUIREMENTS FOR FLAX PRODUCTION

Since there were only two farms each year that grew flax and the average per farm was only 12 acres, there are not sufficient data for a significant range of labor requirements. The average per acre of seed sown during the three years was 32 pounds and the average of twine 2.1 pounds. The average yield was 9½ bushels. By adapting data from the standard requirements for seed-bed preparation operations already given and from the standard requirements for oat production outlined in the discussion of that crop, the requirements shown in Table 26 for flax have been worked up on the basis of the usual practices discussed in the preceding paragraph:

TABLE 26.—*Standard requirements for flax production*

Operation and implement used	Hours of labor		Acres covered in a 10-hour day
	Man	Horse	
Plowing,[1] sulky plow and 3 horses	4	12	2½
Disking, 8-foot disk and 4 horses	½	2	20
Harrowing, 22-foot harrow and 4 horses	⅛	⅘	50
Seeding, 10-foot drill and 4 horses	½	2	20
Cutting	¾	3	13⅓
Shocking	1		10
Shock threshing	2½	4	4

[1] Data for sulky plows are given because a sulky is generally used for sod plowing. They have been increased to allow for the fact that sod plowing is slower than stubble plowing.
Seed, 2 pecks.
Twine, 2¼ pounds.

DISTRIBUTION OF LABOR ON FLAX

In time of seeding, flax has a much wider range than any of the other spring-sown grain crops. The flax plant is frost tender and can not be safely sown as early as oats or barley; but, since it is not subject to rust as are other grains and is less affected by hot weather, it can be sown much later in the spring than any other grain crop. The seeding time on these farms varied from May 14 to June 15. Harvest varied from July 26 to September 5. This elasticity in the time of seeding and harvest makes it possible to fit the crop in at a time when it will interfere least with the labor demands of other crops.

TAME HAY

Tame hay is always seeded with small grain, usually oats, as a nurse crop. Since the seed is either mixed with the grain in the drill box or sown with a grass-seeding attachment to the drill, there is practically no extra labor involved in seeding the crop. Sixty per cent of the tame grass seeded during the three years of this study was a mixture of timothy and red, or alsike, clover. The remainder was clear clover. The practice of seeding clear clover is increasing rapidly. In 1920 less than one-third of the grass seeding was clear clover, but in 1922 two-thirds of the acreage was sown clear. In case of the mixture, the first year's crop is largely clover, but the following year the timothy predominates and increases from year to year until the field is plowed up. Clear-clover seeding is usually cut only one year and then plowed up. It is the usual practice in the Windom area to cut only one crop of tame hay a year and then pasture the field. A small acreage is cut for seed.

Most of the acreage cut for hay is raked, although some is picked up directly from the swath with a hay loader. A small acreage is tedded before raking and some is cocked by hand. Most of the tame hay is hauled into the barn, but any in excess of the mow space, or any from fields distant from the barn, is stacked in the field. Some of the hay stacked is pitched on a wagon or loaded with a loader and pitched onto the stack by hand. Usually, however, a sweep rake and swinging stacker or a bucking pole is used.

LABOR REQUIREMENTS FOR TAME HAY PRODUCTION

The labor requirement for tame hay are shown in Tables 27 and 28. The operation of hauling and stacking includes both hauling to the barn and stacking in the field. Since a portion of the hay from so many fields was put in the barn and the remainder stacked, it has been impossible to separate the requirements for these operations.

TABLE 27.—*Man-labor requirements per acre, by operations for tame hay, 1921*

Farm No.[1]	Acres	Yield	Mowing	Raking	Hauling and stacking	Total
		Tons	*Hours*	*Hours*	*Hours*	*Hours*
7	21	1.0	0.92	0.10	2.12	3.14
11	17	1.6	1.10	.53	3.15	4.78
12	11	1.7	1.25	.18	4.05	5.48
3	17	1.1	.66	.66	4.19	5.51
1	34	1.4	.86	.84	4.01	5.71
6	11	1.5	1.19	.62	4.14	5.95
10	24	1.1	1.09	.38	4.60	6.07
2	23	1.4	1.16	----------	5.32	6.48
4	40	1.8	1.93	.60	4.29	6.82
13	15	1.8	.75	----------	6.41	7.16
22	11	1.8	1.88	.76	4.58	7.22
9	19	1.7	.91	.39	6.21	7.51
8	35	1.5	1.45	.47	6.82	8.74
16	10	2.4	3.67	.41	9.08	13.16
Average:						
14 farms, 1921	21	1.5	1.26	.52	4.84	6.62
13 farms, 1920	19	1.0	1.11	.45	3.76	5.32
14 farms, 1922	20	.9	.95	.51	2.95	4.41

[1] Farms are arrayed in order of total man-labor requirements, beginning with the lowest.

TABLE 28.—*Horse-labor requirements per acre, by operations for tame hay, 1921*

Farm No.[1]	Acres	Yield	Mowing	Raking	Hauling and stacking	Total
		Tons	*Hours*	*Hours*	*Hours*	*Hours*
7	21	1.0	1.84	0.20	4.24	6.28
11	17	1.6	2.20	1.06	2.49	5.75
12	11	1.7	2.50	.36	5.52	8.38
3	17	1.1	1.32	1.32	5.25	7.89
1	34	1.4	1.72	1.64	4.22	7.58
6	11	1.5	2.38	1.14	5.35	8.87
10	24	1.1	2.18	.76	6.73	9.67
2	23	1.4	2.32	----------	7.03	9.35
4	40	1.8	3.86	1.20	6.62	11.68
13	15	1.8	1.50	----------	7.91	9.41
22	11	1.8	3.76	1.52	10.14	15.42
9	19	1.7	1.82	.41	5.09	7.32
8	35	1.5	2.84	.94	4.34	8.12
16	10	2.4	7.34	.82	12.24	20.40
Average:						
14 farms, 1921	21	1.5	2.50	.99	5.80	9.29
13 farms, 1920	19	1.0	2.23	.91	5.04	8.18
14 farms, 1922	20	.9	1.89	1.00	3.77	6.66

[1] Farms are arrayed in order of total man-labor requirements, beginning with the lowest.

CAUSES FOR VARIATIONS IN LABOR REQUIREMENTS FOR TAME HAY

The principal cause for variations in labor required for mowing and for hauling and stacking was yield. The average hours of man labor for mowing for the farms having an average yield or less was 1.05 hours. For farms having more than an average yield, 1.64 hours were spent mowing. The highest labor requirement for mowing, on farm 16, was due to the fact that the grass was so heavy in places that it stood up after it was cut off and the man driving the mower had to get off and pitch it aside with a fork in order to see where to drive. The highest labor requirements for hauling and stacking were found on the farms having the highest yields, farms 13, 16, and 22.

The man and horse labor requirements for raking were figured on the basis of the entire acreage of tame hay whether it was raked or not. Data were not available on the percentage of acreage raked

and not raked. Consequently some of the variations are due to variations in the percentage of total acreage raked. On farm 2 the hay was bucked out of the swath, and on farm 13 it was taken out of the swath with a hay loader. On farms 7 and 12 part of it was also taken out of the swath. On all other farms it was all raked before hauling or stacking. On some farms the hay was raked only into windrows; but on farms 1 and 22, with the highest labor requirements for raking, it was bunched also with a rake. Hauling hay to the barn usually requires more labor than stacking in the field. On farm 12 all tame hay was stacked in the field. On farm 9 it was all hauled to the barn. The yields were the same on both farms, but the labor requirements for stacking were 4.05 man hours and 5.52 horse hours, as compared with 6.21 man hours and 5.09 horse hours for hauling into the barn. The hay in the latter case was put into the mow with slings.

GRASS SEED REQUIREMENTS

The average quantity of clear clover seed sown per acre was 10.2 pounds. Where it was mixed with timothy, the average quantity of clover per acre was 6.1 pounds and of timothy 5.3 pounds. The clear clover seeding varied from 9.3 to 17 pounds per acre and the mixed timothy and clover from 8.3 to 14.6 pounds. The best stands of grass were obtained where at least 10 pounds of clover or 12 to 14 pounds of mixed timothy and clover were sown per acre. Red clover was the variety commonly used, although small amounts of alsike were included in some of the mixtures. (Table 29.)

TABLE 29.—*Standard requirements per acre for tame-hay production in southwestern Minnesota*

Operation and implement used	Hours of labor		Acres covered in a 10-hour day
	Man	Horse	
Mowing, 5-foot mower and 2 horses (1½-ton yield)	1	2	10
Raking, 10-foot rake and 2 horses (1½-ton yield)	½	1	20
Hauling and stacking (1½-ton yield)	4½	5½	2⅕

Seed: Clover, 10 pounds; mixed timothy, 6 pounds; mixed clover, 8 pounds.

DISTRIBUTION OF LABOR ON TAME HAY

Tame hay is usually cut between July 1 and July 15. Ordinarily at least 10 work days of this period would be available for haying operations. The time of cutting tame hay varies with the season. In 1922 some was cut as early as June 20 and in 1920 the bulk of the tame hay work was not completed until July 25. For a given season, however, the work seldom extends over more than two weeks. Tame hay must be cut promptly, in order to insure good quality.

Figure 11 shows the distribution of man labor on 23 acres of tame hay on a Windom farm in 1922. Except for the fact that the cutting is earlier than usual, this distribution is quite characteristic for farms in the area. The tame-hay crop is characterized by heavy labor demands for a short period, with no possibility of shifting them much one way or the other without sacrificing the quality or yield of hay.

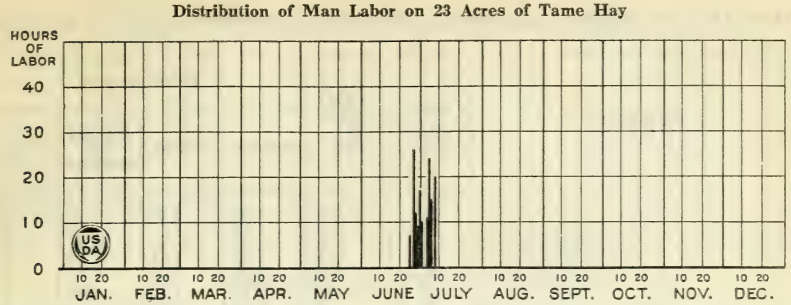

FIG. 11.—The tame-hay harvest and last cultivation of corn keep the farmer busy during the last of June and the first two weeks in July

WILD HAY

Wild hay is handled in much the same way as tame hay. Since it is usually cut later in the season than tame hay when less weather interference is encountered, and since it is less easily damaged by rain, less care is exercised in handling it. It is never tedded and seldom cocked. It is usually stacked in the field. Either a sweep rake and stacker or a bucking pole is used. Unless the first crop is cut early and the summer precipitation is very heavy, a second crop is seldom cut.

LABOR REQUIREMENTS FOR WILD-HAY PRODUCTION

The labor requirements for wild hay are shown in Tables 30 and 31. A small amount of hauling hay to barn is included in the stacking requirements. Since portions of the same field were handled each way, it was impossible to separate the labor for these two operations.

TABLE 30.—*Man-labor requirements per acre, by operations for wild hay, 1921*

Farm No.[1]	Acres per farm	Yield (tons per acre)	Hours per acre			
			Mowing	Raking	Hauling and stacking	Total
7	11	1.0	0.76	0.19	2.00	2.95
2	12	1.9	.56		2.98	3.54
10	5	1.0	1.36	.42	3.32	5.10
9	5	1.1	.90	.57	3.88	5.35
12	13	1.9	1.44	.23	3.86	5.53
20	23	1.8	1.42	.56	3.72	5.70
17	14	1.4	1.64	.83	3.42	5.89
13	3	1.0	1.15	.77	4.98	6.90
15	15	1.6	1.06	1.36	4.70	7.12
6	2	1.1	1.67	.83	5.56	8.06
14	12	1.7	1.72	.16	8.99	10.87
21	27	1.0	2.63	.26	8.55	11.44
Average:						
12 farms, 1921	11.83	1.4	1.52	.52	5.03	7.07
11 farms, 1920	18.12	1.1	1.29	.57	3.54	5.40
9 farms, 1922	12.96	.9	1.08	.47	2.96	4.51

[1] Farms are arrayed in order of total man-labor requirements, beginning with the lowest.

TABLE 31.—*Horse-labor requirements per acre, by operations for wild hay, 1921*

Farm No.[1]	Acres per farm	Yield (tons per acre)	Hours per acre			
			Mowing	Raking	Hauling and stacking	Total
7	11	1.0	1.52	0.38	4.00	5.90
2	12	1.9	1.12		5.32	6.44
10	5	1.0	2.72	.84	6.64	10.20
9	5	1.1	1.80	1.14	3.79	6.73
12	13	1.9	2.87	.45	5.14	8.46
20	23	1.8	2.85	1.12	4.86	8.83
17	14	1.4	3.28	1.66	4.56	9.50
13	3	1.0	2.30	1.54	6.90	10.74
15	15	1.6	2.12	2.72	2.18	7.02
6	2	1.1	3.34	1.66	5.56	10.56
14	12	1.7	3.27	.32	12.10	15.69
21	27	1.0	4.68	.51	14.58	19.77
Average:						
12 farms, 1921	11.83	1.4	3.04	1.04	7.11	11.19
11 farms, 1920	18.12	1.1	2.58	1.11	5.08	8.77
9 farms, 1922	12.96	.9	2.16	.90	4.42	7.48

[1] Farms are arrayed in order of total man-labor requirements, beginning with the lowest.

CAUSES FOR VARIATIONS IN LABOR REQUIREMENTS FOR WILD HAY

The high labor requirements on farms 6 and 13 were due to the small fields. The requirement for each operation was higher than for the corresponding operation on tame hay on these same farms, although the tame hay yield was much higher.

The high labor requirements on farm 21 were due to the fact that the wild hay was on rented land 8 miles distant from the farmstead. The high requirements, especially for hauling, on farm 14, were due to hauling all hay to the barn from a field three-fourths of a mile distant.

The low labor requirements for raking on farms 7, 12, 14, and 21 were due to the fact that only parts of the field were raked. The remainder was picked up directly from the swath with a hay buck. The difference between the hauling and stacking requirements on farms 7 and 10 was due to the fact that all hay on farm 7 was stacked in the field with a sweep rake and stacker, whereas it was all pitched onto a wagon and hauled to the barn on farm 10.

The higher labor requirement for stacking on farm 2, as compared with farm 7, was due to the higher yield. All other conditions on these two farms were comparable. The average labor requirements for the three years also reflect the effect of increased yield in increasing labor requirements.

STANDARD REQUIREMENTS PER ACRE FOR WILD-HAY PRODUCTION IN SOUTHWESTERN MINNESOTA

Those farmers who put up their wild hay with the least labor rake it into windrows, pick it up with a sweep rake, and stack it with a swinging stacker. Assuming these practices and a yield of 1.25 tons per acre, the standard labor requirements for the crop are suggested in Table 32.

TABLE 32.—*Standard requirements for wild-hay production*

Operation and implement used	Hours of labor		Acres covered in a 10-hour day
	Man	Horse	
Mowing, 5-foot mower and 2 horses	1	2	10
Raking, 10-foot rake and 2 horses	½	1	20
Stacking, sweep rake and swinging stacker	3	4½	3⅓

DISTRIBUTION OF LABOR ON WILD HAY

Wild hay as a crop is very elastic in its labor demands. The period at which it is ready to cut varies widely. A wide variety of grasses, varying from Kentucky bluegrass to coarse marsh grasses and sedges, is included. These mature at different times. Some fields are on high, well-drained land, which can be cut at any time; others are on low, wet land that is only dry enough for mowing in late summer. Then, too, the wild grass does not deteriorate so rapidly in palatability or feeding value after it is once ready to cut as do the tame grasses. For this reason the making of wild hay is extended over a considerable period and can be shifted to avoid conflict with the labor demands of other crops to a considerable extent. On these farms wild hay was cut as early as June 24 and as late as September 29. Most of it was cut between July 10 and August 30. Where it is cut earlier than July 10, it is usually with the purpose of getting a second crop.

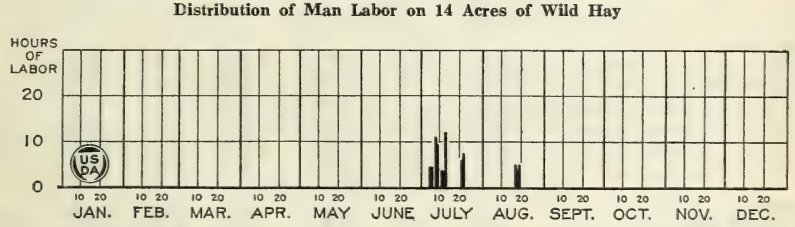
Distribution of Man Labor on 14 Acres of Wild Hay
HOURS OF LABOR
20
10
0
USDA
10 20 JAN. 10 20 FEB. 10 20 MAR. 10 20 APR. 10 20 MAY 10 20 JUNE 10 20 JULY 10 20 AUG. 10 20 SEPT. 10 20 OCT. 10 20 NOV. 10 20 DEC.

FIG. 12.—The quality of wild hay is not dependent upon the time of harvest to such an extent as is the quality of tame hay or alfalfa

Figure 12 shows the distribution of man labor by days on a 14-acre field of wild hay. It illustrates the method of fitting in wild-hay work between other operations. The work was started July 5 after the last cultivation of corn and extended until oat harvest on July 14. Two days, July 21 and 22, between oat harvest and shock threshing, were spent in putting up wild hay; and in August, after shock threshing was over, the work on the crop was completed. It is the usual practice to fit the wild-hay labor in this manner between the operations on other enterprises whose labor demands are less elastic.

ALFALFA

Alfalfa in the Windom area is practically always seeded with small grain as a nurse crop. Oats are generally used. The seed is mixed with the grain and little extra labor is involved. In some cases prepared cultures are used for inoculating the soil, but more often soil from an old alfalfa field is used. In many cases a good stand is

obtained with no artificial inoculation. The practices in putting up alfalfa hay are practically the same as with tame hay. All alfalfa on these farms is hauled directly to the barn. None is stacked in the field. Except for a few small fields used as hog pasture, a first crop is cut on all fields. A second crop is cut on three-quarters of the acreage and a third crop on at least half. Where a second or third crop is not cut, the field is usually pastured. Occasionally a small amount is cut for seed.

LABOR REQUIREMENTS FOR ALFALFA PRODUCTION

The labor requirements for alfalfa are presented in Tables 33 and 34. The principal factor causing variations in the requirements for this crop was yield. This is well illustrated in the first cutting requirements. The labor requirements increased directly with the yield except in cases of farms 14 and 21. On farm 14 the labor was disproportionately high because of the use of family labor. The fact that the requirements for the second cutting were lower than those for the first further illustrates this point. Where alfalfa is cocked before hauling, the hauling requirements are lessened, but the total labor required for the crop is increased.

TABLE 33.—*Man-labor requirements per acre, by operation for alfalfa, 1921*

Farm No.[1]	Acres per farm	Yield per acre	Hours per acre				
			Mowing	Raking	Cocking	Hauling	Total
First cutting:		*Tons*					
15	7.6	0.7	1.05	0.79	0.26	2.24	4.34
10	5.0	.8	1.10	.30		3.14	4.54
21	6.8	.5	1.17	.59	1.46	1.46	4.68
1	5.1	1.2	1.96	.79		4.32	7.07
11	8.0	1.5	1.07	.75		5.40	7.22
14	2.8	1.1	1.08	.54		5.73	7.35
16	2.9	1.7	1.38	1.03		5.86	8.27
6	5.7	2.1	1.58	.26	3.77	4.21	9.82
Average:							
8 farms, 1921	5.5	1.2	1.28	.63	1.66	3.75	7.32
4 farms, 1920	5.2	1.4	1.10	.57	2.07	3.30	7.04
9 farms, 1922	5.1	1.4	1.04	.64		4.06	5.74
Second cutting:							
10	5.0	.3	.75	.55		.60	1.90
15	7.6	1.0	1.05	.66		1.84	3.55
14	2.9	1.1	.72	.72		2.87	4.31
6	5.7	1.2	.88	.44		3.16	4.48
21	6.8	.6	1.61	.66		2.64	4.91
16	2.9	1.0	1.03			4.14	5.17
11	4.4	1.4	1.15	.46		4.13	5.74
Average:							
7 farms, 1921	5.0	.9	1.07	.58	1.93	2.58	6.16
2 farms, 1920	4.1	(2)	.91	.42		1.70	3.03
7 farms, 1922	4.9	.9	.80	.57		2.60	3.97
Third cutting:							
21	6.8	.4	1.46	.59		1.61	3.66
6	5.7	.7	.79	.53		2.46	3.78
11	4.4	.8	1.15	.46		2.29	3.90
16	2.9	.4	1.03	.69		2.76	4.48
15	7.6	.8	1.25	1.05		2.63	4.93
Average:							
5 farms, 1921	5.5	.6	1.17	.69	1.48	2.30	5.64
1 farm, 1920	2.2	(2)	1.35	.90		1.80	4.05
3 farms, 1922	6.5	.5	.63	.33		1.42	2.38

[1] Farms are arrayed in order of total man-labor requirements, beginning with the lowest.
[2] Yield included in first cutting.

TABLE 34.—*Horse-labor requirements per acre, by operations for alfalfa, 1921*

Farm No.[1]	Acres per farm	Yield per acre	Hours per acre			
			Mowing	Raking	Hauling	Total
First cutting:		*Tons*				
15	7.6	0.7	2.10	1.58	2.11	5.79
10	5.0	.8	2.20	.60	3.19	5.99
21	6.8	.5	2.34	1.18	2.64	6.16
1	5.1	1.2	3.92	1.58	4.32	9.82
11	8.0	1.5	2.14	1.50	3.77	7.41
14	2.8	1.1	2.16	1.08	5.73	8.97
16	2.9	1.7	2.76	2.06	11.72	16.54
6	5.7	2.1	3.16	.52	4.56	8.24
Average:						
8 farms, 1921	5.5	1.2	2.55	1.25	4.06	7.86
4 farms, 1920	5.2	1.4	2.20	1.15	3.78	7.13
9 farms, 1922	5.1	1.4	2.08	1.16	4.19	7.43
Second cuttings:						
10	5.0	.3	1.49	1.10	1.19	3.78
15	7.6	1.0	2.10	1.32	2.37	5.79
14	2.8	1.1	1.43	1.43	2.87	5.73
6	5.7	1.2	1.76	.88	3.16	5.80
21	6.8	.6	3.22	1.32	4.10	8.64
16	2.9	1.0	2.06	----------	4.14	6.20
11	4.4	1.4	2.30	.92	6.42	9.64
Average:						
7 farms, 1921	5.0	.9	2.14	1.15	3.35	6.64
2 farms, 1920	4.1	[2]	1.82	.85	2.43	5.10
7 farms, 1922	4.9	.9	1.54	1.04	2.78	5.36
Third cutting:						
21	6.8	.4	2.92	1.18	1.76	5.86
6	5.7	.7	1.58	1.06	3.51	6.15
11	4.4	.8	2.30	.92	2.29	5.51
16	2.9	.4	2.06	1.38	5.52	8.96
15	7.6	.8	2.50	2.10	3.16	7.76
Average:						
5 farms, 1921	5.5	.6	2.34	1.39	2.99	6.72
1 farm, 1920	2.2	[2]	2.70	1.80	3.61	8.11
3 farms, 1922	6.5	.5	1.27	.66	1.32	3.25

[1] Farms are arrayed in order of total man-labor requirements, beginning with the lowest.
[2] Yield included in first cutting.

SEED REQUIREMENTS FOR ALFALFA

The average rate of seeding alfalfa was 12½ pounds per acre. This rate varied from 9 to 15 pounds per acre between different farms. Twelve pounds was the most common rate and proved sufficient in most cases to secure a satisfactory stand.

STANDARD REQUIREMENTS PER ACRE FOR ALFALFA PRODUCTION IN SOUTHWESTERN MINNESOTA

The standard requirements shown in Table 35 for alfalfa are suggested for three cuttings with a total yield of 3 tons.

TABLE 35—*Standard requirements for alfalfa production*

Operation	Hours of labor		Acres covered in a 10-hour day
	Man	Horse	
First cutting:			
Mowing	1¼	2½	8
Raking	½	1	20
Hauling	4½	4½	2¼
Second cutting:			
Mowing	1	2	10
Raking	½	1	20
Hauling	3	3	3⅓
Third cutting:			
Mowing	1	2	10
Raking	½	1	20
Hauling	2½	3	4

Seed, 12 pounds.

DISTRIBUTION OF LABOR ON ALFALFA

Considerable seasonal fluctuation occurs in the dates of the different cuttings of alfalfa. In 1922 some was cut as early as June 5 and in 1920 some was cut for the first time as late as June 26. The second cutting has varied from July 9 to July 31 and the third from August 20 to September 27. The usual dates of cuttings and days available during the period are as follows:

First cutting, June 13 to June 22, 7 days available.
Second cutting, July 15 to July 21, 5 days available.
Third cutting, Sept. 1 to Sept. 10, 6 days available.

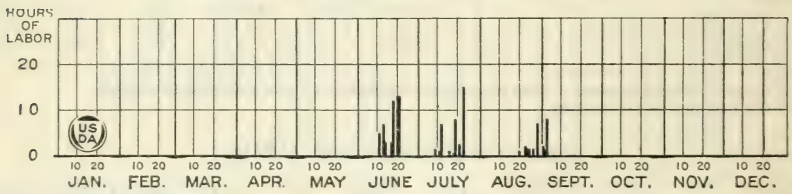
Distribution of Man Labor on 6 Acres of Alfalfa
HOURS OF LABOR
20
10
0
USDA
10 20 10 20 10 20 10 20 10 20 10 20 10 20 10 20 10 20 10 20 10 20 10 20
JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.

FIG. 13.—The first and second cuttings of alfalfa are usually about four weeks apart and the third cutting five to six weeks after the second

Figure 13 shows the labor distribution by days on a field of 6 acres of alfalfa cut three times. The first cutting of alfalfa conflicts with corn cultivation, the second with small-grain harvest, and the third with silo filling, stack threshing, and fall plowing. Like tame hay, the crop is characterized by high labor requirements for short periods of time with little chance of shifting these periods materially. Once alfalfa is ready to cut, it can not be allowed to stand without loss of feeding value for that crop and a lessened yield for the next. After it is cut it must be cured and hauled to the barn as promptly as possible to avoid loss of leaves.

USE OF UNIT REQUIREMENT AND LABOR DISTRIBUTION DATA IN PLANNING A CROPPING SYSTEM

In the presentation of labor requirements by operations for the several crops, a wide range in requirements for each operation has been apparent. The principal causes for these variations have been

noted. Often there are several factors affecting the requirement for a given operation on a particular farm. For example, the labor requirements for husking corn on farm 15 were high, both on account of two men working with one team and because the fields were small and distant from the farmstead. In other instances, the factors causing variations may be exerted in opposite directions and offset each other. For this reason it is impossible to evaluate accurately the effect of each factor in raising or lowering labor requirements. However, it is apparent that low labor requirements are generally associated with large implements, large teams, experienced able-bodied laborers, balanced power, and equipment units, and large fields conveniently located with reference to the farmstead. These conditions make possible standard requirements materially lower than the average. A farmer using these standards requirement in computing the probable labor demand of any cropping system he may be planning should include these factors in his organization, or increase them in proportion to his inability to do so.

The suggested dates for the performance of the various crop operations are usually the most satisfactory and can safely be used in planning the labor program, although seasonal variations will make occasional adjustments necessary for individual years. The number of workdays available for each operation is computed with a fair allowance for weather interference.

In planning a system of cropping for an individual farm these tables of usual dates and days available for the various operations will indicate when different crops will require labor and what competition between crops will occur. By computing the total labor requirements for the acreages of crops planned and comparing them with the workdays available, the farmer may determine whether his labor supply is sufficient to meet the demands at all times with a reasonable margin of safety, or whether he must either change his cropping plan or hire additional labor to handle the heavy demands occurring at certain seasons.

UNIT REQUIREMENTS OF LABOR AND MATERIALS FOR LIVESTOCK

The unit requirements for livestock include hours of man and horse labor and pounds of feeds of the various kinds. In addition to those requirements that can be measured in terms of physical units there are other requirements such as medicine and veterinary services, that can be measured only in terms of money value. Although these occur very irregularly, they have been included in the tables of requirements, because the farmer must in the long run make provision for them. In so far as possible the product of each class of stock is indicated in terms of physical units. Where there are joint products the quantity of each is listed. In case of mature animals, such as horses or cows, the requirements are listed on a per herd basis. Hog requirements are based on 100 pounds of pork produced. For other classes of stock the "animal-unit" [9] basis is

[9] An "animal unit" as defined by the committee on terminology of the American Farm Management Association, now the American Farm Economics Association (see Record of Proceedings of Eighth Annual Meeting, December, 1917, p. 192) represents an average mature horse or cow, or the equivalent in other livestock, based on the amount of feed eaten and manure produced. In this study the following numbers of other livestock will be considered equivalent to a mature horse or cow, 2 colts, 2 young cattle, 5 mature hogs, 10 pigs, 7 mature sheep, 14 lambs, 100 chickens.

used, because they do not have a single physical product and they vary in age and weight so widely that a per head requirement would not be significant.

The roughage requirements for livestock do not include straw. Usually the stock eat from a straw stack at will. Several classes of stock eat from the same stack. Often they trample more under foot, to be later hauled out as manure, than they actually eat. These practices have made it so difficult to get a complete and accurate record of straw consumed by each class of stock that this item has been omitted from the list of requirements. For the same reason no charge has been made for straw used for bedding.

The range of requirements is presented for 1921. The averages for 1920 are also shown. Livestock data for 1922 were not completed in time to be included in this study.

As in the case of crops, the reasons for the variations in requirements are mentioned in so far as is possible. Standard requirements are presented, which represent the accomplishment of those farmers who by their skill in feeding and handling their livestock attain the lowest requirements per unit of product. In computing these requirements, a standard of production is set which, while higher than the average, is easily within the reach of any farmer who follows the better practices in feeding and handling his stock.

WORK HORSES

FEED AND LABOR REQUIREMENTS

The feed and labor requirements for work horses are presented in Table 36. The range of requirements for 1921 is shown together with averages for both 1920 and 1921. All horses are included in this table whether they are brood mares raising colts or geldings used exclusively for work. Labor on horses includes time spent feeding, watering, currying, harnessing, and caring for the horses. It also includes time spent cleaning and bedding the horse barn. It does not include indirect labor on horses, such as grinding feed or hauling hay or straw for them. In addition to feed and labor the amount of miscellaneous cash expense per horse is shown. This includes shoeing, medicine, and veterinary attention. Since it is impossible to reduce this to a physical-unit basis, it is shown as a cash amount. The number of hours worked by a horse is also given

TABLE 36.—*Unit requirements per year for a work horse, 1921*

Farm No.[1]	Horses per farm	Corn	Small grain	Tame hay	Wild hay	Pasture	Total grain	Total roughage	Man labor	Shoeing, veterinary, medicine	Total work
	Number	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Days*	*Lbs.*	*Lbs.*	*Hrs.*	*Dollars*	*Hrs.*
22	7.0	946	42	-------	4,564	148	988	4,564	45	--------	433
7	8.0	-------	1,743	798	2,695	195	1,743	3,493	25	--------	511
20	4.8	626	1,808	-------	3,817	------	2,434	3,817	98	0.44	547
13	4.0	-------	2,457	1,753	2,823	115	2,457	4,576	81	--------	628
12	7.4	841	1,972	1,435	3,353	33	2,813	4,788	82	--------	691
17	4.8	2,155	763	-------	5,351	73	2,918	5,351	93	1.25	701
10	6.0	1,294	948	3,370	2,145	111	2,242	5,515	47	--------	732
19	5.0	2,004	1,500	966	3,141	151	3,504	4,107	65	1.30	737
3	7.0	2,389	1,800	5,233	-------	------	4,189	5,233	89	1.43	780
16	5.2	908	2,240	3,813	-------	113	3,148	3,818	78	--------	792
6	7.0	2,512	682	2,695	2,734	101	3,194	5,429	62	1.07	792
18	5.0	1,118	1,841	-------	7,233	19	2,959	7,233	72	--------	793
11	5.0	339	3,309	5,809	1,600	37	3,648	7,409	85	--------	823
5	6.6	2,956	433	-------	5,970	88	3,389	5,970	83	.21	831
9	5.9	1,687	2,435	2,387	4,007	86	4,122	6,394	46	--------	834
2	8.8	2,820	909	2,301	3,360	71	3,729	5,661	69	2.32	858
21	2.8	1,523	2,072	1,958	6,401	------	3,595	8,359	82	3.38	885
1	8.0	1,056	2,243	6,970	-------	90	3,299	6,970	51	--------	896
4	7.0	3,113	2,690	3,715	5,616	24	5,803	9,331	235	.43	910
8	6.0	2,432	2,787	4,440	-------	------	5,219	4,440	72	--------	1,003
14	5.3	2,839	1,009	749	7,008	60	3,848	7,757	82	1.05	1,069
15	3.4	3,927	1,513	-------	7,582	15	5,440	7,582	123	.59	1,238
Average:											
130 horses, 1921	--------	1,708	1,646	2,350	3,376	74	3,354	5,726	79	.57	780
132 horses, 1920	--------	1,397	1,774	2,725	2,266	60	3,171	4,991	78	.71	824

[1] Farms are arrayed in order of hours worked, beginning with the lowest.

CAUSES FOR VARIATIONS IN FEED REQUIREMENTS

The largest number of hours of work per horse was performed on farm 15, which has the highest feed requirements of any farm except farm 4. The latter has much larger horses and raises colts in addition to working the horses. The lightest grain feeding was practiced on farm 22, on which horses were worked the fewest number of hours.

The extensive use of pasture saves hay or grain, or both, as is shown by the farms using most pasture—7, 19, and 22. The hay requirements are low on all three and the grain very low on 7 and 22. The grain feed is usually heavier where it consists largely of corn, and the roughage feeding is heavier where it consists largely of wild hay.

The heavier feeding of both hay and grain in 1921 as compared with 1920 is due in part to the fact that the price of feeds had decreased so greatly that less economy in their use was practiced in 1921.

CAUSES FOR VARIATION IN MAN LABOR ON HORSES

In general, the more horses per farm the less labor required per horse. There are several operations, such as feeding, where the time spent per horse does not increase as the number of horses increases. It does not take twice as long to feed the eight horses on farm 1 as it does to feed the four on farm 13.

On farms 7, 19, and 22, where the greatest use of pasture for horses is obtained, the chore labor on horses is least. The labor of feeding and currying the horses, as well as cleaning and bedding the barn, is saved when the horses are on pasture.

Higher labor requirements are found on farm 15, where the horses worked the largest number of hours.

The work horses on farm 4 included four purebred mares from which three colts were raised. The extra labor involved in breeding the mares, attending them at foaling time, and caring for the colts until weaning time is included in the total labor requirement. This purebred stock was given much more attention than most grade stock receives. The time spent in fitting them and showing them at the county fair further increased the labor charged against them.

SHOEING, VETERINARY AND MEDICINE COSTS

The miscellaneous cash costs were highest on farm 21, since a team was used for daily milk deliveries, and kept shod all year for this purpose. All other items over a dollar per horse consist largely of shoeing, except on farm 17, where this item covers veterinary service. The difference between 1920 and 1921 represents largely a difference in price levels.

STANDARD REQUIREMENTS FOR HORSES

The following standard requirements are suggested for a 1,500-pound horse working 1,000 hours a year.

Grain	4,000 pounds	Man labor	80 hours
Roughage	6,000 do	Cash costs	60 cents
Pasture	45 days		

DISTRIBUTION OF MAN LABOR ON HORSES

Figure 14 shows the distribution of man labor expended on horses on a farm having an average of 6.6 horses for the year. The labor runs fairly uniformly during most of the year. The peak requirements come during the rush of putting in the corn crop and cultivating

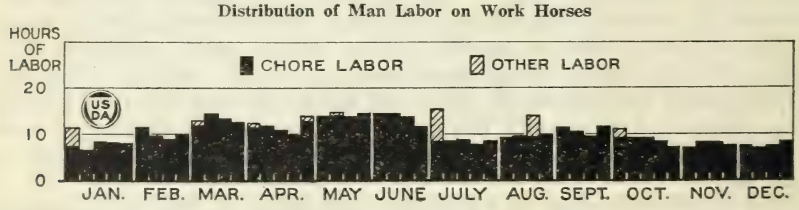

FIG. 14.—Work horses get more attention during the rush season than when they are not doing much work. The distribution of man labor is shown by weeks

it. From July to the close of the year the use of pasture cuts down the chore hours on horses. In the fall and through the winter the horses run in stalk-field pastures. This pasturing of stalk fields is common in the area and reduces the chores on horses during the fall and winter.

COLTS

The unit requirements for colts are presented in Table 37. The colt enterprise included yearlings, 2-year-olds, and even 3-year-old unbroken horses. On account of this variability in ages and the fact that the feed and labor for the different ages could not be separated, the requirements have been computed on the animal-unit basis.[10]

[10] See footnote 6, page 14.

TABLE 37.—*Unit requirements per animal unit per year for colts, 1921*

Farm No.[1]	Head	Corn	Oats	Tame hay and alfalfa	Wild hay and fodder	Pasture[2]	Total grain	Total roughage	Labor		Veterinary medicine
									Man	Horse	
	No	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Days*	*Lbs.*	*Lbs.*	*Hours*	*Hours*	*Dollars*
6	0.4	1,660	1,195	6,050	------	------	2,855	6,050	------	------	------
10	.7	1,417	------	1,012	817	89	1,417	1,829	------	------	------
18	1.4	833	1,628	------	4,433	64	2,461	4,433	47	------	------
12	2.0	680	972	606	1,955	77	1,652	2,561	------	------	------
15	2.8	1,497	749	------	3,738	146	2,246	3,738	1	------	------
19	3.0	173	100	747	1,055	184	273	1,802	------	------	------
9	3.1	1,000	1,244	------	3,631	322	2,244	3,631	5	------	------
7	4.0	------	------	38	147	223	------	185	------	------	0.67
22	4.0	294	------	------	3,195	165	294	3,195	------	------	------
3	4.0	586	------	------	567	207	586	567	1	1.0	------
2	4.4	997	341	821	957	310	1,338	1,778	------	------	------
14	9.0	148	------	------	486	272	148	486	8	9.5	------
4	14.2	816	1,155	780	577	43	1,971	1,357	1	------	------
Average:											
53 head, 1921	4.1	598	527	354	1,248	173	1,125	1,602	3	2	.07
48 head, 1920	3.4	608	318	1,129	730	216	926	1,859	17	3	.14

[1] Farms are arrayed in order of number of head per farm, beginning with the lowest.
[2] Pasture is expressed in terms of animal unit days. This must be multiplied by the number of head composing an animal unit to get actual days of pasture. For example, 100 animal unit days of pasture for a 1-year old colt is the equivalent of 200 days spent on pasture.

FEED REQUIREMENT FOR COLTS

The wide variations in feed requirements for colts represent largely differences in practices on different farms. Usually more grain is fed to colts under 1 year than to older animals. Colts were born during the year on farms 4, 6, 10, 15, and 18. These farms show high grain-feeding requirements. Usually less grain is fed where a large amount of pasture is utilized. Farm 9 is an exception to this, because grain was fed while the colts were on pasture. On farm 7 there were four yearling colts that received no grain and very little roughage. They ran in the pasture and stalk fields part of the year and received a ration of oat straw the remainder of the time. They made little growth during the year. On farms 3 and 14 liberal feeding of straw was practiced, and on most of the farms straw formed part of the ration for colts. No record was kept of the amount of straw fed.

LABOR REQUIREMENTS FOR COLTS

Very little labor is required for colts in addition to that expended on work horses. In this study all labor on colts until they were weaned is included with that on work horses. After weaning, the colts spend most of their time in the pasture or stalk fields and require little care. The time spent daily on colts was usually so small that it was not reported. Farm 18 reported the largest amount of labor expended on colts. This consisted largely in caring for a fall colt. Spring colts are turned out on pasture soon after birth, but fall colts require more care and stabling.

STANDARD REQUIREMENTS FOR COLTS

On account of the variety of practices in raising colts on these farms, it is practically impossible to work out significant standards.

DAIRY COWS

In 1921 there were seven herds, in which all the cows were milked by hand throughout their period of lactation and for which a record of the entire milk and butterfat production for the year is therefore available. These dairy herds are bred to freshen during the late fall and winter. Forty-two per cent of the calves in 1921 were born during October, November, and December, and 46 per cent from January to April, inclusive. The disposition of the calves is considered under the discussion of young dairy stock. The product of these cows is marketed as cream in nearly every case. The milk is separated on the farm and fed to calves and hogs. The cream is sold to the local creamery or to shipping stations. In case sweet cream is sold, it must be delivered at least three times a week in summer and twice a week in winter. One farmer bottled his whole milk and maintained a milk route in Windom. On another farm the cream was churned and the butter sold in town. The general method of caring for and handling these cows is indicated in the discussion of causes for variations in feed, labor, and production.

The quantities of feed and labor and the production per cow for these herds are presented in Table 38. On farms 15, 17, and 21 the herds consisted of grade and purebred Holsteins and Jerseys. The remaining four herds were composed almost entirely of grade Shorthorns. The labor includes not only the regular chore hours spent in milking, feeding, cleaning barn, and bedding cows, but also marketing milk and any special work on cows that is done at irregular times, such as caring for a sick cow, buying cows, or testing for tuberculosis. The production record is based on butterfat actually utilized. It includes butterfat marketed, that contained in milk, cream, and butter used in the house, and that in whole milk fed to calves.

TABLE 38.—*Unit requirements per year for a dairy cow, 1921*

Farm No.[1]	Cows per farm	Corn	Small grain	Oil meal	Tame hay	Wild hay	Alfalfa	Corn fodder	Corn silage
	Number	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
1	13. 9	1, 133	46	-------	1, 061	-------	-------	1, 684	-------
8	10. 4	181	169	-------	199	-------	-------	256	5, 495
9	9. 1	407	-------	-------	1, 424	543	-------	659	2, 440
6	11. 2	650	1, 302	-------	433	134	2, 720	923	-------
17	5. 7	422	2, 260	-------	-------	1, 729	-------	2, 776	-------
15	8. 1	1, 210	918	50	-------	367	1, 456	-------	9, 821
21	8. 6	2, 776	2, 916	233	624	832	2, 061	2, 684	-------
Average:									
67 cows, 1921	-------	963	933	36	596	397	892	1, 217	2, 365
90 cows, 1920	-------	283	194	1	1, 247	452	148	709	1, 561

Farm No.[1]	Pasture	Total grain	Total dry roughage	Labor		Veterinary and medicine	Milk production	Butterfat production
				Man	Horse			
	Days	*Pounds*	*Pounds*	*Hours*	*Hours*	*Dollars*	*Pounds*	*Pounds*
1	229	1, 179	2, 745	118	2	0. 12	3, 198	124
8	264	350	455	122	25	-------	3, 270	131
9	229	407	2, 626	147	3	. 63	3, 539	132
6	201	1, 952	4, 210	123	-------	1. 73	5, 321	208
17	211	2, 682	4, 505	213	16	-------	4. 651	217
15	182	2, 178	1, 823	272	2	. 72	7, 570	260
21	171	5, 925	6, 201	459	35	1. 37	7, 726	290
Average:								
67 cows, 1921	215	1, 932	3, 102	194	11	. 66	4, 841	186
90 cows, 1920	199	478	2, 556	150	10	. 14	3, 293	132

[1] Farms are arrayed in order of butterfat production, beginning with the lowest.

CAUSES FOR VARIATIONS IN FEED REQUIREMENTS FOR DAIRY COWS

The amount of feed required by a dairy herd is determined by the farmer who feeds them. It is varied according to his judgment and to his available supply of feed. In general, the greater the amount of pasture used the less the amount of grain and hay fed. Silage reduces the amount of dry roughage fed. In general, the cows were fed according to production and the heaviest producers received the most feed. The grain fed per cow was more than four times as great in 1921 as in 1920. This was due in large measure to the low price of feeds that year as compared with the price of dairy products. Grain had declined in price so much more proportionately than had butterfat that the dairy cow offered a relatively better market for it than she had the previous year. Part of this large difference in grain requirements between the two years is, however, due to a change in the herds included in the study. Only four of the same herds were included both years. The grain feed for these herds was doubled in 1921 with a resulting increase of 30 per cent in butterfat production. The three herds added in 1921 were fed over seven times as much grain per cow as the average of the herds they displaced and produced 60 per cent more butterfat.

CAUSES FOR VARIATIONS IN LABOR REQUIREMENTS FOR DAIRY COWS

In general, the labor per cow decreased as the size of the herd increased. Milking is the only operation for which labor varies directly with the number of cows.

On farms 1 and 8, where the largest utilization of pasture was made, the man-labor requirements were lowest. These herds received very little feed while on pasture. Farm 9 reported as many pasture days per cow as farm 1; but the cows were fed grain and hay while on pasture, thus increasing labor requirements.

On farms 15 and 17 the cows were fed either grain or silage all but one month of the year and on farm 21 every month. On the farms with lower man-labor requirements little, if any, feed was supplied in addition to pasture during six months of the year.

The high man and horse labor requirements for farm 21 were due to the fact that all milk was bottled and delivered in Windom as whole milk. Other farms sold cream which was delivered only two or three times a week. Farms 8 and 17 used horses largely in hauling cream and their horse-labor requirements were higher than on those farms where cream was delivered with an automobile.

On farms 15 and 21 the cows were stabled practically every day in winter. On farm 17 the cows were stabled most of the winter and on farm 9 part of the time. On the remaining farms they were turned out in the yard during all but the severest weather.

CAUSES FOR VARIATIONS IN PRODUCTION OF BUTTERFAT

The four highest producing herds were much more heavily fed than the low producers. The grain ration for the low producers was largely corn, whereas the high producers received considerable small grain and in two cases oil meal. Three of the four highest producing herds received alfalfa hay.

As has already been noted, the three highest producing herds were stabled practically all winter. These herds and that on farm 6 were

in pasture a shorter time than the others. Since the extension of the pasture season beyond about 200 days involves the use of cornstalk pastures, which are really of little value for milk production, it is to be expected that the long pasture season will decrease rather than increase milk production. On farms 6, 15, 17, and 21 the cows were fed some extra feed during the summer while on pasture. This was especially important, because the rainfall in May and June was much below normal in 1921,[11] and pastures were very short. On farm 15 the skill of the farmer in combining feeds and handling the herd was apparently an important factor in the high production.

The higher production of the herds composed of cows of the generally recognized dairy breeds is undoubtedly due to their inherited capacity for feed consumption and the fact that they utilize a relatively larger amount of the feed consumed for production and less for bodily maintenance.

The herd on farm 15 was composed of individuals of excellent dairy type and breeding. Their individual productive capacity, coupled with the skillful feeding and handling on the part of the farmer, undoubtedly accounts in a large measure for their higher production in proportion to the feed received than the herds on farms 17 and 21.

VETERINARY AND MEDICINE COSTS

The item of cash expense for veterinary service and for medicine varies quite widely. Most of it is incurred for veterinary services. The high expense on farms 6 and 21 is due to the fact that all cows on these farms were tested for tuberculosis.

STANDARD REQUIREMENTS FOR DAIRY CATTLE

The following are suggested as standard requirements for a cow of dairy breeding producing 200 pounds of butterfat per year in a herd of at least 10 cows given the care and attention essential to successful dairying:

Grain	pounds	1, 400
Hay—alfalfa or clover	do	2, 000
Silage [12]	do	6, 000
Pasture	days	180
Man labor	hours	150
Horse labor	do	10
Cash costs (veterinary and medicine)	cents	35

DISTRIBUTION OF LABOR ON DAIRY COWS

Figure 15 shows the distribution of man labor by weeks on a dairy herd averaging eight cows for the year. The black portion of each bar represents the regular daily work on cows, such as milking, separating the milk, feeding, cleaning barn, and bedding. The hachured portions of the bars represent time spent marketing cream, extra work on cows such as caring for a sick cow, and any work done only at irregular intervals. These cows were stabled every day during cold weather. From the latter part of March until they went on pasture they were turned out in the yard during the day and stabled

[11] See fig. 2, p. 4.

[12] In case no silage was available, an additional 2,000 pounds of hay would be required and possibly some additional grain.

only at night. They were in the pasture until November, when they were turned into the stalk fields. Beginning the first week in December, they were confined to the yard and by the last of the month

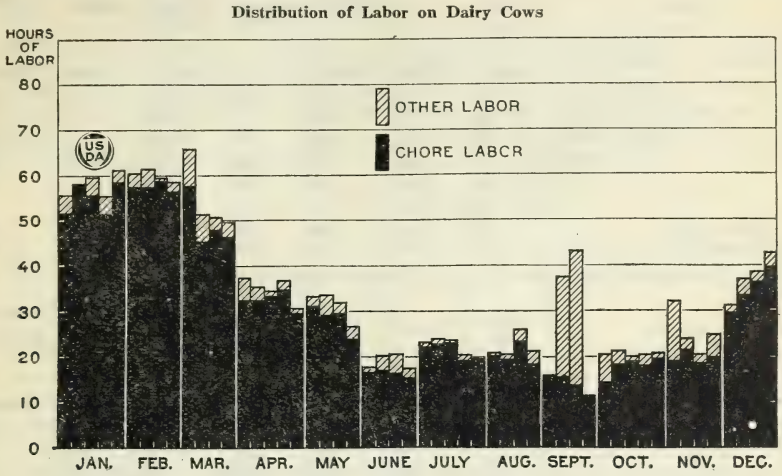

FIG. 15.—The cows are usually on pasture during the summer when the farmer is rushed with field work and receive less attention than during the winter months

YOUNG DAIRY CATTLE

were kept in the barn all the time. This labor distribution is typical of the better dairy herds where the cows are stabled in winter and given the care and attention necessary for high production.

Young dairy cattle include not only heifers being raised for sale or use in the herd, or bulls raised for sale as breeding stock, but also calves to be vealed, and both heifers and steers to be sold as stockers or feeders or to be fed on the farm. The number of head of young dairy cattle is less on those farms where Holsteins and Jerseys are kept, because the male calves are nearly all vealed and only the heifers raised. On the farms where Shorthorn cows are milked, few veals are sold. The male calves are castrated and raised for sale as yearling or 2-year-old steers. The large number of young cattle on farm 1 (Table 39) is due to the fact that all calves are raised and retained in the herd until 2 or 3 years of age. There are the calves from at least three years on hand all the time.

The usual practice in handling calves in these dairy herds is to wean them a few days after birth, feed them on whole milk for a short time, and then gradually replace this with skim milk. Extensive utilization of pasture and roughage is practiced with this young stock. Liberal grain feeding is only practiced in case of the older animals, expecially steers that are being fattened.

The unit requirements for these young dairy cattle are presented in Table 39. Since this class includes all ages and weights of cattle from veal calves to heavy 2 and even 3 year old steers, unit requirements are based on an animal unit.[13] No attempt has been made to compute a physical product for this class of cattle other than the number maintained.

[13] See footnote [6], p. 14.

TABLE 39.—*Unit requirements per animal unit per year for young dairy stock, 1921*

Farm No.[1]	Head	Corn	Small grain	Tame hay and alfalfa	Wild hay and fodder	Silage	Skimmed milk
	Number	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
21	6	955	861	1,319	1,038	----------	----------
15	11	766	2,083	2,616	471	6,268	2,212
17	14	54	751	----------	2,598	----------	----------
8	17	268	371	700	634	6,278	1,651
9	21	66	358	----------	369	5,034	1,847
6	24	1,798	574	1,101	1,153	----------	1,996
1	50	2,900	129	1,530	1,063	----------	489
Average:							
143 head, 1921	20	1,477	506	1,067	1,026	1,957	1,148
201 head, 1920	20	335	225	1,545	927	1,502	1,044

Farm No.[1]	Whole milk	Pasture[2]	Total grain	Total dry roughage	Labor		Veterinary and medicine
					Man	Horse	
	Pounds	*Days*	*Pounds*	*Pounds*	*Hours*	*Hours*	*Dollars*
21	357	99	1,816	2,357	33	----------	----------
15	470	76	2,849	3,087	63	1.6	0.12
17	----------	194	805	2,598	23	1.9	----------
8	252	153	639	1,334	26	2.4	----------
9	215	178	424	369	15	1.4	----------
6	348	151	2,372	2,254	36	1.3	1.46
1	186	185	3,029	2,593	12	.3	----------
Average:							
143 head, 1921	237	163	1,983	2,093	24	1.1	.26
201 head, 1920	159	198	560	2,472	19	2.7	.14

[1] Farms are arrayed in order of number of head per farm, beginning with the lowest.
[2] See footnote 2, Table 37, p. 49.

VARIATIONS IN FEED REQUIREMENTS FOR YOUNG DAIRY CATTLE

The feed for the young cattle is varied, as in the case of dairy cows, according to the farmer's judgment in handling his cattle. There was such a large variation in the type of cattle included in this enterprise that a wide diversity in the labor and feed expended on them occurred. The heaviest feeding was practiced on farm 15. The young cattle on this farm were grade or purebred Holsteins that the owner was attempting to grow to as large size as possible. He therefore fed quite liberally. The heavy feeding on farm 1 was due to the fact that there were included in the enterprise twenty-one 2 and 3 year old steers on a heavy fattening ration. Except in case of farm 1, where these steers were on feed, the large use of pasture was associated with low grain and roughage requirements.

CAUSES FOR VARIATIONS IN LABOR REQUIREMENTS

On farms 6, 15, and 21, which had the highest man-labor requirements, the least use was made of pasture. More labor is required to care for stock in the barn or yard than when running on pasture.

On farms 6, 15, and 21, which had the highest man-labor requirements, more grain per animal unit was fed than on any others except farm 1. On these farms the grain was fed largely to calves and yearlings in the barn. This involved much more labor than was required on farm 1, where most of the grain was fed out of doors in bulk quantities to a carload of fattening cattle.

The saving of labor as herds increase in size is somewhat obscured by the other variables affecting labor. However, on farms 1, 8, and 9 conditions were fairly comparable and labor per animal unit decreased as the size of herd increased.

On farm 15 the young cattle consisted largely of purebred or grade heifers. These were not turned on pasture as young as was the case on most farms. They were stabled at night for at least six months of the year, were kept in the barn both day and night during severe weather in winter, and received much more individual care and attention than did the grade stock of beef breeding.

VETERINARY AND MEDICINE COSTS

Very little is spent for veterinary services or medicine for young cattle. The high cost on farm 6 is due to the fact that all these cattle were tested for tuberculosis.

STANDARD REQUIREMENTS FOR YOUNG DAIRY CATTLE

On account of the small number of herds included in this study and the high degree of variability both in the type of cattle included in this classification and in feeding and handling methods practiced, it is impossible to set standard requirements for this class of cattle that will have any significance.

DISTRIBUTION OF MAN LABOR ON YOUNG DAIRY CATTLE

Figure 16 indicates the distribution of man labor by weeks on young dairy cattle on a farm having an average of 14 head. The high labor peak in February is due to the fact that all the calves were born during this month. The decrease in labor the latter part of

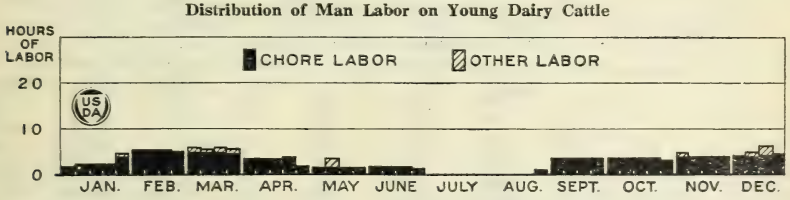

FIG. 16.—The young dairy cattle ordinarily get very little attention while they are on pasture during the summer months

April is due to the fact that the yearlings were turned on pasture at this time. The young calves were turned on pasture the first of June and received no additional feed or care until the last of August. From then until the close of the year they were in the pasture or stalk fields, but received additional feed. At no time during the year did this class of cattle receive as much as six hours of labor a week. Most of this labor comes during the slack season and is so small in total that it is of little importance in planning the labor program for the farm.

MIXED CATTLE

The mixed cattle enterprise, as found on these farms, contains an element of diversity that makes it flexible and capable of adjustment to changing price conditions. When the price of butterfat is high

relative to beef prices, all the cows in the herd can be milked and the calves either vealed or raised on skim milk. Should the price of butterfat drop below beef relatively, these same cows may be allowed to nurse their calves and their entire product marketed as beef. During the years of this study butterfat was relatively high in price and more cows were being milked than would ordinarily be the case. About one-third of the cattle in these mixed herds were cows. The remainder were calves, yearlings, and 2-year-olds. From 15 to 20 per cent of all calves born were sold as veal. The remainder were raised to be retained in the breeding herd or sold as stockers, feeders, or fat cattle.

TABLE 40.—*Unit requirements per animal unit per year for mixed cattle enterprise, 1921*

Farm No.[1]	Head	Corn	Small grain	Tame hay and alfalfa	Wild hay	Fodder	Silage	Pasture [2]
	Number	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Days*
2	81	1,887	106	1,243	1,083	-------	-------	275
22	15	-------	16	-------	3,299	404	-------	225
12	34	399	117	818	1,296	1,318	-------	163
7	38	375	131	206	920	210	2,795	240
14	33	539	68	328	61	185	6,520	188
10	16	449	459	1,446	96	-------	-------	226
13	25	191	826	1,702	198	1,315	-------	160
19	17	1,069	538	516	1,049	779	-------	248
3	31	572	120	488	-------	1,230	-------	213
18	23	358	81	-------	1,044	-------	5,959	196
5	27	427	116	-------	1,226	1,167	-------	253
11	30	662	447	1,750	-------	272	6,549	148
16	23	198	67	1,887	-------	355	7,112	236
20	26	2,065	454	-------	2,969	783	3,221	151
4	89	1,424	891	1,748	24	57	2,176	198
Average:								
508 head, 1921	34	897	350	971	753	455	2,178	210
321 head, 1920	29	431	176	1,312	757	673	2,489	188

Farm No.[1]	Total grain	Total dry roughage	Labor		Veterinary, medicine, etc.	Value of product	
			Man	Horse		Stock	Dairy products
	Pounds	*Pounds*	*Hours*	*Hours*	*Dollars*	*Dollars*	*Dollars*
2	1,993	2,326	38	2.3	0.34	15.40	5.69
22	16	3,703	69	7.6	-------	10.09	13.01
12	516	3,432	54	.8	-------	8.76	16.52
7	506	1,336	32	2.8	-------	21.84	7.33
14	607	574	90	6.0	-------	13.88	16.17
10	908	1,542	81	2.8	.05	7.41	23.09
13	1,017	3,215	83	1.1	1.32	16.72	14.51
19	1,607	2,344	81	2.9	.15	8.51	29.36
3	692	1,718	59	.5	.12	26.80	13.16
18	439	1,044	74	4.3	.35	25.82	15.16
5	543	2,393	76	4.1	-------	16.22	25.91
11	1,109	2,022	105	2.5	.12	13.79	28.93
16	265	2,242	114	1.9	-------	8.75	36.06
20	2,519	3,752	105	1.9	.16	20.25	35.21
4	2,315	1,829	74	2.2	-------	35.64	21.49
Average:							
508 head, 1921	1,247	2,179	72	2.6	.17	19.37	19.02
321 head, 1920	607	2,742	63	4.6	.21	19.90	27.12

[1] Farms are arrayed in order of total value of product, beginning with the lowest.
[2] See footnote 2, Table 37, p. 49.

On one farm the calves were fed out as baby beef and sold at about 18 months of age. There was considerable range in the time of the year that the calves were dropped. They were fairly evenly distributed through the year from November to May, inclusive. Few calves were born during the summer and early fall. As has already been noted, there was a wide range between different farms in the

proportion of cows milked by hand and those allowed to nurse their calves. Some cows nursed their calves throughout their lactation, whereas others were allowed to nurse the calves only a part of the time and many not at all. The general plan of handling these cattle other than in the manner of milking differs little from that of the dairy herds of Shorthorn breeding. The product of the cows milked is marketed as cream.

The unit requirements for the mixed cattle enterprise are shown in Table 40. Since the age and size of the individuals composing these herds varied so widely, the requirements are computed on an animal-unit bases.[14] Under value of stock are included all sales of breeding, feeding, and fat stock, as well as any increase in cattle on hand. Fluctuations due to changing price levels in opening and closing inventories have been eliminated. The dairy products include all cream sold, all dairy products used in the house, and skim milk fed to swine and poultry. The lower value of dairy products in 1921 as compared with 1920 is largely due to lower prices received. At least as many dairy products were produced in 1921 relatively to beef as in 1920. The reason the price deflation did not affect the value of the stock produced is that little stock was sold in 1920 until after prices had fallen. The two years are on very nearly the same price basis for stock, but not for dairy products.

FEED REQUIREMENTS FOR MIXED CATTLE

The variability of the enterprise, as well as the difference in systems of management on different farms, produced a wide range in feed requirements. Liberal silage feeding is usually associated with low grain or dry roughage requirements. On farms 4 and 20, having the highest value product per farm, the heaviest feeding was practiced. The higher feed requirements on farm 20 are due to the fact that dairy production was emphasized relatively more than on farm 4. On both these farms grade Shorthorn cows of the milking strain were kept and the calves raised for beef fed on the farm and sold as fat cattle. (See Table 40.)

CAUSE FOR VARIATIONS IN LABOR REQUIREMENTS

On all farms on which more than the usual amount of dairy products were produced the man labor per animal unit was correspondingly high. Man labor, on the other hand, did not increase so definitely with increased value of stock product.

In general, the man labor per animal unit decreased as the size of the herd increased.

On farms 11, 16, and 20, having the highest man-labor requirements, all cattle were put in the barn, at least at night, all winter and were fed largely in the barn. On most farms part of the young cattle, especially feeding cattle, were fed in the yard and had only an open shed for shelter.

VETERINARY AND MEDICINE COSTS

Very little is spent for veterinary services or medicine for mixed cattle. The large cost reported on farm 13 was incurred for testing the herd for tuberculosis.

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[14] See footnote [6], p. 14.

STANDARD REQUIREMENTS FOR MIXED CATTLE

The diversity of type of individuals composing these mixed cattle herds, as well as of methods of handling them and of products produced, makes it impossible to set up significant standards for them.

DISTRIBUTION OF LABOR ON MIXED CATTLE

Figure 17 shows the distribution of man labor by weeks on 30 head of mixed cattle. This number included 13 cows, 10 of which were milked at least part of the time. These cattle were turned out on

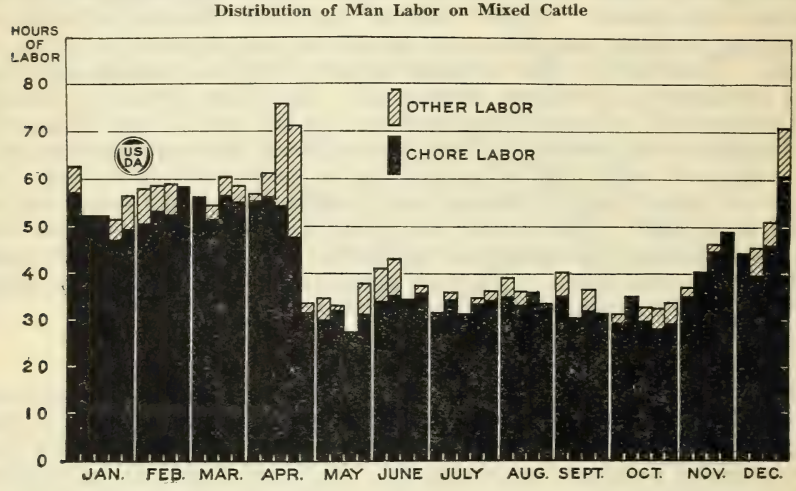

FIG. 17.—The amount of labor falls off sharply when the cattle are turned out on pasture

pasture the last of April. Part of them were taken off pasture early in November, but the rest had the run of the stalk fields until the latter part of December. The large amount of special labor in April was spent marketing cattle.

HOGS

Hogs are maintained on most of these farms for pork production. On several, however, a purebred breeding herd is established and a large number of animals are sold for breeding purposes. Spring farrowing is the common practice. Fall litters are produced on only about 25 per cent of the farms. Gilts are used largely for breeding on the pork-producing farms, but aged sows predominate in the purebred herds. Pigs are farrowed about March 1 for breeding purposes, but the litters to be fed out for pork are not farrowed until April or May. The average weight at which hogs were marketed for pork in 1921 was 233 pounds. This varied between different farms from 188 to 292 pounds. If aged breeding stuff is eliminated, the average weight at which pigs farrowed in the spring and fed out directly for pork were sold was about 200 pounds. Nineteen per cent of hogs sold for pork were marketed in December; 21 per cent in January, and 12 per cent in February. The remaining 48 per cent were distributed through the remainder of the year.

Corn is the principal feed for hogs. The small grain fed is almost exclusively oats. On a few farms a small amount of mill feeds or

tankage is fed, but skim milk is the principal protein concentrate on most of these farms. The pasture includes rape, alfalfa, clover, timothy, and bluegrass.

The feed and labor requirements for pork production are presented in Table 41. The pounds of pork produced represent the net gain in weight of all hogs on the farm during the year. The weights of hogs sold for either market or breeding purposes, of hogs butchered for farm consumption, and of hogs on hand at the end of the year are added together and from their sum is subtracted the weight of hogs on hand at the beginning of the year and any purchased during the year. The remainder is the net worth of pork produced during the year. No allowance is made for hogs that die during the year, hence this figure is net in that it covers death risk. The feed is shown on the basis of the requirement for the production of 100 pounds net gain in weight. It includes feed for the breeding herd that produces the pigs which are fed for market.

TABLE 41.—*Unit requirements for the production of 100 pounds of pork, 1921*

Farm No.[1]	Corn	Small grain	Mill feeds	Total grain	Tankage	Skim milk	Pasture[2]	Labor		Veterinary and medicine	Pork produced
								Man	Horse		
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Days*	*Hours*	*Hours*	*Dolls.*	*Lbs.*
8	458	53	------	511	-------	355	1.8	9.2	1.6	--------	2,330
18	508	81	------	589	-------	118	9.1	4.4	.9	--------	3,515
2	304	7	3	314	4.0	143	6.0	3.7	1.1	--------	3,745
21	474	145	8	627	-------	8	9.7	4.6	------	--------	4,795
20	354	48	------	402	1.4	363	4.9	3.6	.3	0.39	7,112
1	489	28	------	517	-------	262	1.9	3.4	.4	.26	7,662
22	449	67	2	518	.2	46	5.0	4.6	.9	--------	8,160
14	382	53	------	435	-------	33	6.6	3.6	.3	.32	9,498
12	585	6	------	591	2.0	57	------	4.1	.6	--------	10,222
7	336	6	------	342	-------	80	6.1	1.4	.9	--------	10,647
17	367	117	------	484	-------	133	------	3.9	.6	.11	11,575
15	278	66	------	344	-------	229	3.5	2.7	.6	.40	13,327
11	439	94	------	533	-------	101	3.0	4.0	.6	.47	13,347
9	396	------	------	396	1.4	43	7.3	2.8	.5	.11	14,202
4	541	5	------	546	-------	166	3.7	.5	.4	.01	15,630
16	426	39	------	465	-------	226	4.8	3.4	.2	--------	16,335
10	453	55	------	508	-------	65	3.9	2.3	.3	.28	18,045
19	334	47	2	383	5.0	40	8.7	2.9	.4	--------	20,111
6	475	108	------	583	1.2	119	3.5	3.2	.1	.62	20,442
5	574	44	------	618	1.0	99	.5	3.4	.1	.12	20,718
3	372	43	3	418	.9	12	3.0	3.8	.5	.30	22,315
13	449	64	26	539	6.3	12	7.5	3.6	.2	.47	36,132
Average:											
289,865 pounds, 1921	432	53	4	489	4.0	98	4.5	3.2	.4	.23	13,176
148,753 pounds, 1920	461	27	7	495	2.0	98	5.1	3.9	.9	.23	9,917

[1] Farms are arrayed in order of total pork production per farm, beginning with the lowest.
[2] See footnote 2, Table 37, p. 49.

CAUSES FOR VARIATIONS IN FEED REQUIREMENTS FOR HOGS

There were over seven pigs per litter on farm 15, which had one of the lowest grain requirements for hogs. On farm 21, having the highest requirements, there were only three pigs per litter. Since the feed fed to breeding stock is charged against the hogs actually marketed, the larger the litters the smaller will be the portion of the charge against an individual hog.

On farms 6 and 13 the high feed requirements are in part due to the fact that the brood sows were largely aged sows weighing 400 to 500 pounds. On most farms gilts of only about half these weights were used. On farm 2, with the lowest feed requirement, no feed for

breeding stock is included, as no pigs were farrowed. All hogs fed that were not on hand at the beginning of the year were purchased.

On farms 5 and 21, having the highest feed requirements, blue-grass pasture was used. On farm 15 alfalfa pasture was used, and on farm 9 clover was used; both farms have low feed requirements.

On farm 20 grain was saved by a liberal feeding of skim milk. On farm 19 the use of tankage saved considerable grain.

Part of the hogs on farms 2 and 7 ran with cattle that were on feed and salvaged some of the grain wasted by the cattle. It was impossible to get any record of the amount of grain thus obtained by the hogs, but it was a factor in reducing the amount of grain necessary to feed directly to them.

High feed requirements on farm 5 are in part due to the heavy death losses. Sixteen pigs were lost after weaning and three mature hogs died during the year.

CAUSES FOR VARIATIONS IN LABOR REQUIREMENTS FOR HOGS

The labor required to produce 100 pounds of pork is greater on the farms producing the smallest amounts. The average for the 11 farms producing the least pork was 3.8 man hours and 0.6 horse hour. For the 11 farms producing the most pork, the labor requirement was 3 man hours and 0.4 horse hour. It takes very little longer to feed 60 hogs than it does to feed 30.

On farm 4, having the lowest labor requirements for hogs, the principal feeds were corn and skim milk. The feeding floor was adjacent to the corncrib and very close to the separator room. Very little time was required for feeding. Water was piped to automatic waterers in the hog lots. Much of the year the feeding hogs ran with the feeding cattle and there was no charge against them for cleaning or bedding the shed where they were housed.

The harvesting of corn by hogs not only saves labor on the corn crop but lessens the labor cost of caring for the hogs. On farms 10 and 15 large acreages of corn were hogged off. On farm 4, with the lowest labor requirements, half of the corn received by the hogs was harvested by them.

On farm 13, although the largest number of pounds of pork was produced, convenient facilities for feeding were available, and 1,000 bushels of corn were hogged down, the labor requirements were higher than the average. All hogs on this farm were purebreds and a large number were sold for breeding purposes. A bred-sow sale was held, which added considerably to the labor requirements. Since animals sold for breeding purposes are often marketed individually, this adds to the labor. The horse labor was not so high in proportion as the man labor on this farm, because an auto truck was used for hauling hogs.

VETERINARY AND MEDICINE COSTS

On all farms where the item of veterinary services and medicine is over 20 cents per 100 pounds, it consists largely of the cost of cholera serum and vaccination. The high costs for this item on farms 6, 11, and 13 are due to the use of combined serum and virus treatment. The other items of cash expense are disinfectants and hog powder.

Standard requirements per 100 pounds for pork production

Grain	pounds	425
Skim milk	do	150
Or tankage	do	15
Pasture: clover, alfalfa, or rape, 7 animal unit days.		
Labor:		
Man	hours	3. 5
Horse	do	0. 5

Good-sized litters and low death loses are neccssary to the accomplishment of these requirements. Unless at least six pigs per sow are raised to maturity, the grain requirement may prove somewhat low.

DISTRIBUTION OF LABOR ON HOGS

Figure 18 shows the weekly distribution of labor on hogs on a farm producing 16,000 pounds of pork in a year. The labor requirement is fairly uniform during most of the year. Less labor is required while the hogs are on pasture or in the cornfield than when fed in a

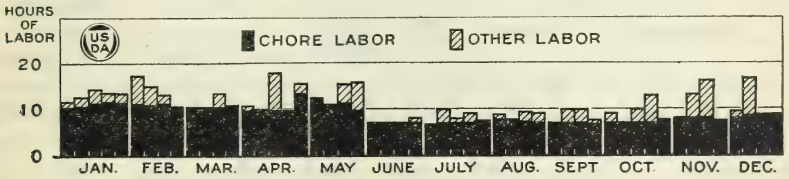

FIG. 18.—Hogs require more labor at farrowing time and when they are marketed. This labor conflicts very little with the field labor on crops

dry lot. The occasional high peaks, such as occurred during the latter part of November and the middle of December are due to marketing hogs, vaccinating for cholera, or similar extra operations not occurring regularly. Labor increases as farrowing time approaches and the peak is reached during or just after farrowing. The pigs on this farm were farrowed during April and the first 10 days of May. This is also a period of high labor requirements for crops, and the hog enterprise competes with them in its demand for labor during these months. This competition, however, is not important, because the total amount of labor on hogs is comparatively small and the competition may be avoided altogether by earlier farrowing. This labor distribution on hogs is quite representative for the area.

SHEEP

Sheep are a minor enterprise on most of these farms and receive little feed or care. They are pastured in the farmstead, along roads and lanes, in grain fields after harvest, or anywhere there is grass or weeds that they will consume. They serve a useful purpose in cleaning weeds out of the fields and farmsteads. On only a few farms are the flocks large enough to require much feed in addition to what they pick up for themselves about the farm. Most of the lambs, except those retained in the flock for breeding purposes, are marketed in September and October. They are sold directly from grass and receive no grain.

The unit requirements for sheep are presented in Table 42. Since the enterprise includes all ages and weights of sheep from young lambs to aged ewes, the requirements have been computed on an animal-unit basis.[15]

TABLE 42.—*Unit requirements per animal unit per year for sheep, 1921*

Farm number[1]	Head	Corn	Small grain	Tame hay and alfalfa	Wild hay and fodder	Silage
	Number	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
10	6					
15	12			549		3,437
6	16		252	528	609	
17	22	73	243		287	
14	23	219				1,435
13	29		1,603	355		
7	30		166	20		219
18	43	59	159			5,804
Average: 181 sheep, 1921	23	52	360	142	90	1,861
391 sheep, 1920	43	124	164	1,099	347	871

Farm number[1]	Pasture[2]	Total grain	Total dry roughage	Labor		Production	
				Man	Horse	Wool	Mutton
	Days	*Pounds*	*Pounds*	*Hours*	*Hours*	*Pounds*	*Pounds*
10	289			21		56	338
15	209		549	33	4.9	43	299
6	160	252	1,137	22	4.6	51	325
17	139	316	287	13	6.7	31	395
14	161	219		41	2.1	61	141
13	247	1,603	355	30		52	345
7	212	166	20	10	3.3	53	387
18	226	218		29	2.5	48	89
Average: 181 sheep, 1921	203	412	232	25	2.8	49	264
391 sheep, 1920	201	288	1,446	29	4.5	50	352

[1] Farms are arrayed in order of number of sheep per farm, beginning with the lowest.
[2] See footnote 2, Table 37, p. 49.

FEED REQUIREMENTS FOR SHEEP

The feed requirements for sheep vary widely, because of the chance amounts of feed that the sheep salvage about the farm and farmstead of which it is impossible to keep any record. Where silage is fed, usually little other roughage is used. On most farms grain is only fed for one to three months prior to and during lambing, but on farm 13 the ewes were fed a liberal grain ration for six months beginning in December.

LABOR REQUIREMENTS FOR SHEEP

Very little labor is expended on sheep except at lambing time. The rest of the year they receive attention irregularly as they need it. The tendency for labor per unit to decrease as the size of the enterprise increased that was noticed in case of other classes of stock does not obtain with sheep. It is offset by the fact that the larger flocks can not shift for themselves as do the small ones, but must have some attention from the farmer.

[15] See footnote 6, p. 14.

PRODUCTION OF MUTTON AND WOOL

The production of mutton and wool per animal unit was fairly uniform for the different farms. The low wool production reported on farm 17 is due to the fact that 48 mature sheep that were on the farm at the beginning of the year were sold just before shearing time. They are, however, included in computing animal units, because their feed is included with that for the remainder of the flock. This fact reduces the wool per animal unit, so that it can not be compared with the wool production of other flocks. The low mutton production on farm 18 is due to the loss of half of all the lambs born. Most of these were lost after they were several months old. On farm 14 the loss of two mature ewes and several lambs accounts for the low mutton production.

STANDARD REQUIREMENTS FOR SHEEP PRODUCTION

As with other minor enterprises, especially where a joint product is involved, it is difficult to set up standard requirements for sheep. The labor will vary according to the size of the flock and the method of handling. The feed actually fed will be determined in part by the additional amount of otherwise waste products which can be utilized. A reasonable production of mutton and wool to be expected under representative farm conditions in this area where no unusual losses occur would be 50 pounds of wool and 350 pounds of mutton per animal unit.

DISTRIBUTION OF MAN LABOR ON SHEEP

Figure 19 shows the weekly distribution of man labor on sheep on a farm having 11 breeding ewes. Nineteen lambs were raised

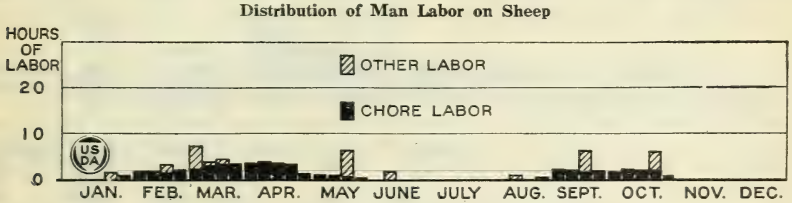

FIG. 19.—Sheep need careful attention at lambing time in the spring. The marketing of lambs takes considerable labor in September and October

and sold in September and October. The peak load of labor came during lambing time in March and April. The lambs also received some extra care just before they were sold. The large amount of special labor in March was spent in preparing pens for the ewes about to lamb. The peak in May consisted of shearing sheep and in September and October of marketing lambs. At no time during the year do sheep require sufficient labor to interfere seriously with any other enterprise.

POULTRY

The unit requirements for poultry are presented in Table 43. These requirements are for 100 fowls. Pullets and cockrels grown and sold during the year are not included in the number of poultry on the farm, but their feed is included with that of the breeding flock that produced them. The physical product is listed in terms

of both eggs and poultry. On all but one farm both products were produced, but in widely varying proportions.

The feed requirements listed include only the feed actually fed out to the chickens. In addition to this, they foraged about the farmstead and adjoining fields for a considerable part of their living. Most of the feed they picked up would otherwise have been wasted. The labor on poultry was performed largely by women and children, but this has been reduced to a man-labor equivalent in computing the labor requirements. (See Table 43.)

TABLE 43.—*Unit requirements per year for 100 chickens, 1921*

Farm No.[1]	Chickens	Corn	Oats	Other small grain	Mill-feeds	Total grain
	Number	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
17	55	2,760	2,620	545	----------	5,925
10	62	4,013	1,411	----------	----------	5,424
19	70	1,251	2,493	----------	----------	3,744
2	80	709	1,296	1,128	----------	3,133
12	90	1,726	648	----------	----------	2,374
18	91	2,203	1,472	----------	----------	3,675
8	97	4,370	708	55	----------	5,133
22	100	1,643	1,728	----------	----------	3,371
13	110	3,359	1,231	----------	----------	4,590
9	125	1,544	1,389	----------	----------	2,933
6	125	1,164	1,673	----------	80	2,317
14	150	2,076	319	----------	----------	2,395
5	160	1,792	808	68	----------	2,668
4	167	2,751	490	----------	----------	3,241
1	170	1,422	616	128	----------	2,166
11	170	1,020	1,121	290	147	2,578
15	214	1,632	1,249	----------	280	3,161
3	246	1,673	1,061	----------	31	2,765
20	264	1,088	1,992	1,136	161	4,377
16	278	983	2,440	112	288	3,823
Average:						
2,824 chickens, 1921	141	1,820	1,301	191	80	3,392
1,778 chickens, 1920	99	2,248	1,568	373	54	4,243

Farm No.[1]	Skim-milk	Labor		Medicine and disinfectant	Eggs laid	Poultry produced
		Man	Horse			
	Pounds	*Hours*	*Labor*	*Dollars*	*Number*	*Pounds*
17	----------	495	5.5	----------	6,578	529
10	574	371	3.2	4.73	5,248	471
19	1,157	252	13.6	1.71	3,983	421
2	----------	232	7.5	.31	3,549	152
12	----------	206	6.7	4.56	4,609	196
18	1,179	321	10.4	4.71	6,716	([2])
8	----------	169	35.1	----------	1,839	779
22	372	151	----------	2.76	6,418	110
13	----------	133	10.0	----------	3,856	150
9	309	187	1.6	----------	4,428	293
6	791	161	9.6	2.55	6,638	27
14	1,583	134	5.3	----------	4,449	575
5	----------	234	14.7	.31	5,880	186
4	----------	382	7.2	1.08	3,966	474
1	----------	240	6.8	----------	3,949	350
11	1,234	170	1.8	1.16	4,282	312
15	2,865	293	14.5	----------	5,907	377
3	616	192	4.1	3.25	3,905	496
20	725	124	----------	.85	6,659	568
16	1,198	223	1.1	1.29	5,115	187
Average:						
2,824 chickens, 1921	756	219	7.0	1.32	4,950	344
1,778 chickens, 1920	304	267	16.6	1.71	5,210	447

[1] Farms are arrayed in order of number of chickens per farm, beginning with the lowest.

[2] Most of the chickens hatched died during the year. Only enough survived to maintain the breeding flock.

VARIATIONS IN FEED REQUIREMENTS FOR POULTRY

The feed requirements for poultry vary according to the methods of conducting the enterprise and the conditions on individual farms. On some farms there is considerable waste grain and other products that are utilized by poultry, whereas on others there is little such available and the poultry are fed marketable feeds. Usually considerably more grain is fed where a large number of pounds of poultry is produced. The grain requirement follows poultry production more closely than it does egg production. Little chicks can not forage for so large a proportion of their feed as can laying hens. The heavier feeding in 1920 as compared with 1921 was largely due to the difference in the number of pounds of poultry produced.

CAUSES OF VARIATIONS IN LABOR REQUIREMENTS FOR POULTRY

More labor is required where incubators and brooders are used than where the chicks are hatched and raised with hens. Farms 4, 15, and 18 used incubators and brooders and their labor requirements were higher than farms 8, 14, and 20 that raised a larger number of chickens but used hens.

More man labor per 100 hens is expended on the smaller flocks in most cases. The smallest flock, and the highest labor requirements were found on farm 17. There are, however, exceptions to this, as in case of farm 4. Here a large amount of poultry was raised and incubators and brooders were used.

On the majority of the farms there was considerable trouble with various poultry diseases. It was necessary to disinfect poultry houses frequently and medicine was resorted to in many cases.

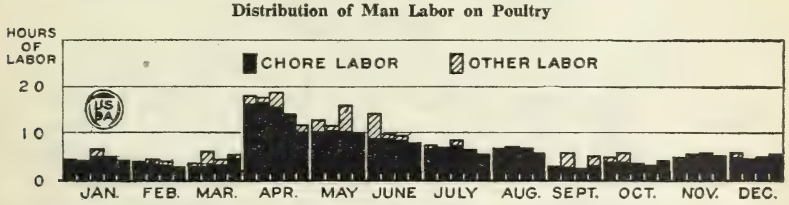

FIG. 20.—The farm poultry flock requires a relatively small amount of labor. The hatching and care of chickens during the spring and early summer is usually looked after by the farmer's wife or children

STANDARD REQUIREMENTS FOR POULTRY

On account of the varying conditions under which poultry are kept and their minor place in the farm organization, it is difficult to work out standard requirements that might be generally applicable. However, the results secured with the higher producing flocks indicate that under representative farm conditions as they exist in the area a flock of from 100 to 150 or 200 chickens producing 6,000 eggs and 475 pounds of poultry annually per 100 birds could be maintained with the following unit requirements:

Labor, man hours		225
Labor, horse hours		10
Grain [16]	pounds	4,000
Medicine and disinfectants	dollars	1.50

[16] Skim milk could be substituted for part of the grain at the rate of 6 pounds of milk for every pound of grain replaced.

DISTRIBUTION OF MAN LABOR ON POULTRY

Figure 20 shows the weekly distribution of man labor on a flock of 160 chickens. The peak labor load came during April, when most of the chicks were hatched. The large amounts of special labor in May and June were spent cleaning and disinfecting the poultry house. Since poultry require comparatively little labor, and this is performed by women or children, it interferes little, if at all, with the major enterprises of the farm.

MISCELLANEOUS LABOR REQUIREMENTS AND THEIR RELATION TO THE CROP AND LIVESTOCK LABOR

The labor requirements already presented included only the regular work on crops and the different classes of livestock. In addition to this regular labor on crops and livestock, a large amount of work of miscellaneous or maintenance character must be performed. This labor is divided into manure hauling, miscellaneous crop and livestock labor, and maintenance labor.

MANURE HAULING

An average of 10 per cent of the crop acreage of the farms studied is manured each year at the rate of 10 loads per acre. One-third of the manure hauling is done during March and April. Ten per cent is done in each of the three months—January, February and August. Practically none is hauled during June and very little in July and October. The rest of this work is scattered throughout the remainder of the year. The labor spent hauling manure is shown in Table 44.

TABLE 44.—*Manure hauling, 1921*

Farm No.[1]	Crop acres per farm	Animal units per farm	Total hours of labor		Loads hauled	Acres covered	Hours of labor per acre		Loads per crop acre covered	Per cent crop acres covered
			Man	Horse			Man	Horse		
5	195	37	78	220	75	8	9.75	27.5	9.4	4.1
10	123	30	107	278	106	6	17.84	46.33	17.7	4.9
3	191	45	134	255	130	10	13.40	25.50	13.0	5.2
19	69	29	58	167	47	4	14.50	41.75	11.8	5.8
18	74	31	58	155	60	5	11.60	31.00	12.0	6.8
17	102	29	123	247	95	8	15.38	30.88	11.9	7.8
8	128	28	161	213	109	10	16.10	21.30	10.9	7.8
12	122	40	114	242	100	10	11.40	24.20	10.0	8.2
1	226	55	268	365	222	19	14.11	19.21	11.7	8.4
7	145	45	76	204	79	13	5.85	15.69	6.1	9.0
14	109	35	188	336	129	11	17.09	30.55	11.7	10.1
2	238	61	190	377	220	24	7.92	15.71	9.2	10.1
15	110	27	154	262	143	12	12.83	21.83	11.9	10.9
16	89	35	84	162	86	10	8.40	16.20	8.6	11.2
21	71	18	90	184	75	8	11.25	23.00	9.4	11.3
6	160	45	142	265	171	19	7.47	13.95	9.0	11.9
4	240	82	412	876	325	30	13.73	39.20	10.8	12.5
20	78	30	188	238	144	10	18.80	23.80	14.4	12.8
11	112	34	209	311	171	16	13.06	19.44	10.7	14.3
9	132	35	122	368	118	20	6.1	18.40	5.9	15.2
22	52	26	64	130	61	8	8.00	16.25	7.6	15.4
13	99	52	198	393	253	28	7.07	14.04	9.0	28.3
Average per farm	130	39	146	284	133	13	11.14	21.62	10.2	10.0

[1] Farms are arrayed in order of percentage of crop acreage manured, beginning with the lowest.

Manure hauling is a task that can be shifted about in the labor program considerably. On some farms all manure is hauled directly from the barn to the field during most of the year. Since 73 per cent of the manure is applied to land that is to be planted to corn, the large amount of hauling in the spring represents the hauling out of the winter's accumulation as soon as it thaws, in order that it may be plowed under before the crop is planted. Eighteen per cent of the manure hauled is applied to land to be seeded to small grain and 9 per cent to hay and pasture land. This hauling is fairly well distributed throughout the year.

MISCELLANEOUS CROP LABOR

The labor requirements for crops as shown is preceding tables include only direct field work involved in producing these crops. They do not include labor expended in cleaning or treating seed, purchase of seed or materials required, cleaning grain or shelling corn for market, or any marketing work. The amount of this labor varied on different farms from 1 to 14 per cent of the total direct labor on crops. The average amount was 7 per cent of the man labor and 3½ per cent of the horse labor. The amount of this "other labor" on crops on each farm in 1921 is shown in Table 45.

MISCELLANEOUS LIVESTOCK LABOR

The livestock labor presented heretofore includes only the regular daily chore work of feeding, bedding, milking cows, cleaning barns, and regular care of stock; and also such special work as caring for sick animals, buying and selling stock; and any other direct work on stock performed at irregular intervals. In addition to this there is considerable time spent on each farm hauling and grinding feed, hauling bedding, and other operations which indirectly maintain the livestock and which usually serve several classes of stock jointly. The amount of this labor may range from 1 per cent of the direct man labor to as much as 14 per cent. The average amount of the farms studied was 6½ per cent of the total direct man labor. On most farms the horse labor of this type exceeded the total direct horse labor on livestock, and the average amount was 40 per cent greater than the average amount of direct horse labor. The amount of this labor as well as the total hours on livestock on each farm in 1921 is shown in Table 45.

MAINTENANCE LABOR

In addition to the direct and indirect labor required in the conduct of the crop and livestock enterprises, there is a considerable amount of maintenance or general upkeep work that is essential to the operation of the farm but is not directly chargeable to any enterprise or group of enterprises. Furthermore, this is often unnecessary when choice of enterprises is the objective, because the amount of this work is usually affected only slightly by the choice between the different crops or kinds of livestock. However, it must be considered in any attempt to forecast the labor program for a year. The amount of this labor on each farm is shown in Table 45, divided into five classes, and the total indicated as maintenance labor.

TABLE 45.—*Distribution of total labor, by farms, 1921*

MAN LABOR

Farm No.[1]	Crop acre per farm	Animal units per farm	Real estate [2]	Machinery [3]	General expense [4]	Household [5]	Garden potatoes, and orchard [6]	Total maintenance	Livestock		Crops		Total labor on farm	Percentage maintenance labor of total labor
									Chores	Other	Field	Other		
			Hours	*Hours*	*Hours*	*Hours*	*Hours*	*Hours*	*Hours*	*Hours*	*Hours*	*Hours*	*Hours*	*Per cent*
7	145	45	66	49	37	43	7	202	1,181	50	1,387	64	2,884	7.0
22	52	26	115	81	92	266	144	698	1,528	67	850	80	3,223	21.7
19	69	29	120	85	81	101	64	451	2,059	298	945	138	3,891	11.6
17	102	29	40	36	46	69	26	217	2,609	136	1,034	54	4,050	5.4
18	74	31	258	157	116	189	28	748	2,211	91	1,102	116	4,268	17.6
10	123	30	203	321	171	305	120	1,120	1,902	92	1,295	59	4,468	25.1
20	78	30	162	32	13	93	48	348	3,138	149	1,139	82	4,856	7.2
9	132	35	182	161	28	122	154	647	2,402	55	1,858	116	5,078	12.7
16	89	35	187	20	58	62	22	349	3,655	124	1,305	31	5,464	6.4
8	128	28	177	83	109	292	75	736	2,299	192	2,090	257	5,574	13.2
12	122	40	157	172	160	226	66	781	2,471	336	1,880	155	5,623	13.9
13	99	52	231	83	115	232	89	750	3,488	144	1,261	56	5,699	13.2
3	191	45	70	34	45	130	72	351	3,195	205	1,847	220	5,818	6.0
6	160	45	137	112	45	38	70	402	3,137	208	2,066	189	6,002	6.7
21	71	18	338	76	38		13	465	4,505	172	893	15	6,050	7.7
14	109	35	114	147	95	259	202	817	2,744	32	2,318	210	6,121	13.3
5	195	37	133	151	9	118	85	496	3,178	174	2,128	165	6,141	8.1
2	238	61	143	50	29	175	6	403	2,723	346	2,480	202	6,154	6.5
11	112	34	486	205	129	139	57	1,016	3,563	195	1,941	111	6,826	14.9
15	110	27	317	129	109	259	39	853	4,002	211	1,832	67	6,965	12.2
1	226	55	239	259	132	107	157	894	3,035	347	2,861	302	7,439	12.0
4	240	82	161	113	45	126	138	583	7,847	298	2,360	67	11,155	5.2
Average:														
22 farms, 1921	130	39	188	116	77	152	76	609	3,040	178	1,676	125	5,628	10.8
21 farms, 1920	130	37	436	133	119	163	73	924	2,528	190	1,896	118	5,656	16.3

7	145	45	79	28	34	18	15	174	145	84	3,336	76	3,815	4.6
22	52	26	61	26	123	152	59	421	152	124	1,917	34	2,648	15.9
19	69	29	52	19	113	41	30	255	139	476	2,574	72	3,516	7.3
17	102	29	26	16	35	76	36	189	198	271	2,405	62	3,125	6.0
18	74	31	266	42	62	64	47	481	128	142	2,758	139	3,648	13.2
10	123	30	78	26	32	79	101	316	110	149	3,534	70	4,179	7.6
20	78	30	125		11	24	34	194	100	188	2,084	81	2,647	7.3
9	132	35	77	17	2	80	20	196	116	90	4,416	122	4,940	4.0
16	89	35	34	4	22	17	12	89	71	214	2,836	32	3,242	2.7
8	128	28	94	16	105	283	23	521	353	111	3,863	217	5,065	10.3
12	122	40	147	49	48	43	29	316	90	177	4,145	123	4,851	6.5
13	99	52	73		17	19	36	145	100	222	2,077		2,544	5.7
3	191	45	35	7	2	63	46	153	159	320	4,245	337	5,214	2.9
6	160	45	29	11		27	45	112	156	292	4,614	190	5,364	2.1
21	71	18	124	22	48		5	199	321	317	1,682	12	2,531	7.9
14	109	35	30	12	25	114	127	308	209	64	4,572	278	5,431	5.7
5	195	37	74	25		49	51	199	125	326	4,657	197	5,504	3.6
2	238	61	110	22		6	9	147	152	661	6,188	331	7,479	2.0
11	112	34	205	13	19	28	18	283	144	57	3,576	22	4,082	6.9
15	110	27	152	31	22	80	29	314	149	132	3,287	4	3,886	8.1
1	226	55	170	16	58	41	66	351	85	298	5,455	380	6,569	5.3
4	240	82	105	16	34	70	30	255	214	523	5,267	24	6,283	4.1
Average:														
22 farms, 1921	130	39	98	19	37	62	39	255	155	238	3,613	127	4,388	5.8
21 farms, 1920	130	37	196	29	81	106	34	446	215	272	3,937	136	5,006	8.9

[1] Farms are arrayed in order of total hours of man labor on the farm, beginning with the lowest.

[2] "Real Estate" labor consists of repair and upkeep work on buildings, fences, drains, water systems, lighting plants, etc., as well as the making of new improvements.

[3] Under "Machinery" labor is included the time spent repairing machinery, purchasing machinery, or purchasing materials for repair work.

[4] "General expense" labor consists of trimming trees, mowing yards and lawns, office work in connection with the farm business, time spent looking for laborers to hire, work on public or farm roads, time spent attending farmers' organization meetings, and other tasks which can not be allocated even indirectly to any individual enterprise.

[5] "Household" labor includes the time spent in cutting and hauling wood, purchasing household supplies, hauling coal, and similar tasks ordinarily performed by men on the farm. It does not include any of the routine household tasks, even though they may be performed by the farmer or his hired help.

[6] Under "Garden, potatoes, and orchard" is included the time spent in raising food for consumption on the farm.

The relative amount of this maintenance work varies widely between different farms and different years. In 1921 the range was from 5.2 per cent to 25.1 per cent of all man labor on the farm and from 2 to 15.9 per cent of the total horse labor. There was much less of this type of labor in 1921 than in 1920. The much larger amount of real estate work in 1920 as compared with 1921 is due to building construction and tiling undertaken that year. On account of the low prices of farm products prevailing in 1921 practically all construction work was postponed until the farmer should be better able to finance it. This type of work can be shifted at the farmer's convenience during any given year and can usually be shifted considerably during a period of years. In planning the labor supply for a farm or in planning an organization that will best utilize the available supply of labor, due allowance must be made for these items of manure hauling, indirect labor on crops and livestock, and the various kinds of maintenance labor in addition to the direct labor already considered in the discussion of labor requirements for the individual crop and livestock enterprises.

THE PLACE OF THE CROP, LIVESTOCK, AND MISCELLANEOUS LABOR IN THE LABOR PROGRAM OF THE FARM

A representative distribution of labor for each of the important crops and kinds of livestock has already been shown. In order to avoid an undesirable piling up of the labor requirements, the farmer must have a knowledge of the way in which these requirements are distributed. The usual dates for performing the various operations characteristic of the major crops grown in the Windom area are shown in Figure 21. These dates may vary somewhat from year to year, but their general sequence remains substantially the same.

There are certain periods during the growing season when several crops compete with each other for the farmer's time. Small-grain seeding conflicts with plowing for corn, alfalfa, and tame hay with corn cultivation, and stack threshing and rye seeding with silo filling and corn cutting. At other times such as during corn cultivation in June or corn husking and fall plowing, only one crop provides employment for labor. Small grains conflict with each other in their labor requirements but compete with corn very little. The different kinds of hay conflict little with each other but compete with either small grains or corn for labor. The cropping plan for a farm must be so adjusted as to reduce these conflicts to a minimum and yet provide as regular and continuous a succession of crop work throughout the season as possible.

The labor on crops is seasonal and comes only at certain fairly definite periods during the year, but the livestock labor is distributed throughout the year. The different classes of livestock require labor simultaneously, but this competition for labor is not so important in the case of some classes of stock as the competition for feed, pasture, and building equipment.

The distribution of man labor on livestock by weeks on a farm maintaining 34 animal units [17] of livestock is presented in figure 22. The "all-stock" labor corresponds to the "other" livestock labor in Table 45, and includes such work as hauling feed, grinding feed, and hauling bedding. The different classes of stock vary somewhat

[17] See footnote 6, p. 14.

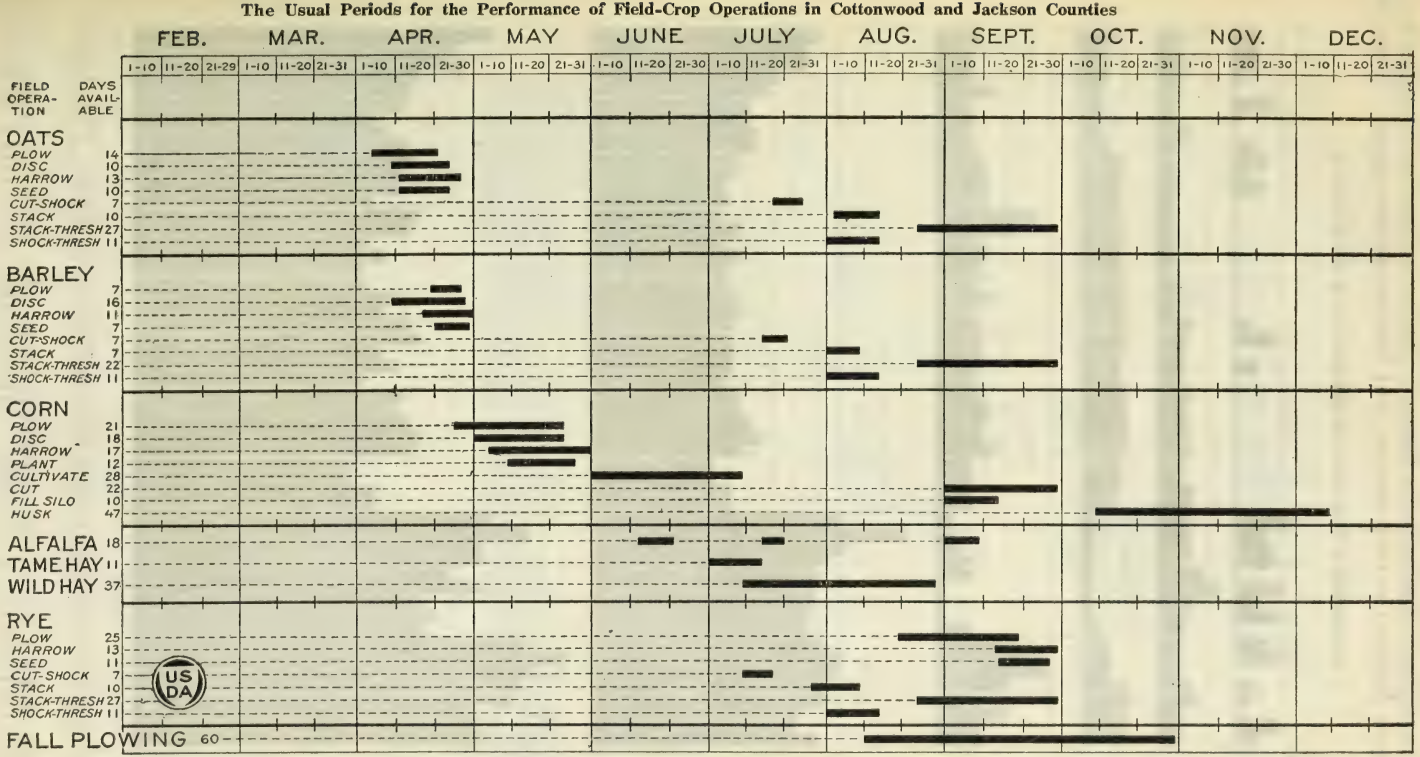

FIG. 21.—The different crops use the farmer's labor and equipment at different times of the year. The labor on corn is scattered throughout the year more widely than that on any other crop

in their seasonal demands for labor. Cattle require considerably less attention during the crop season, but horses require more. Most of

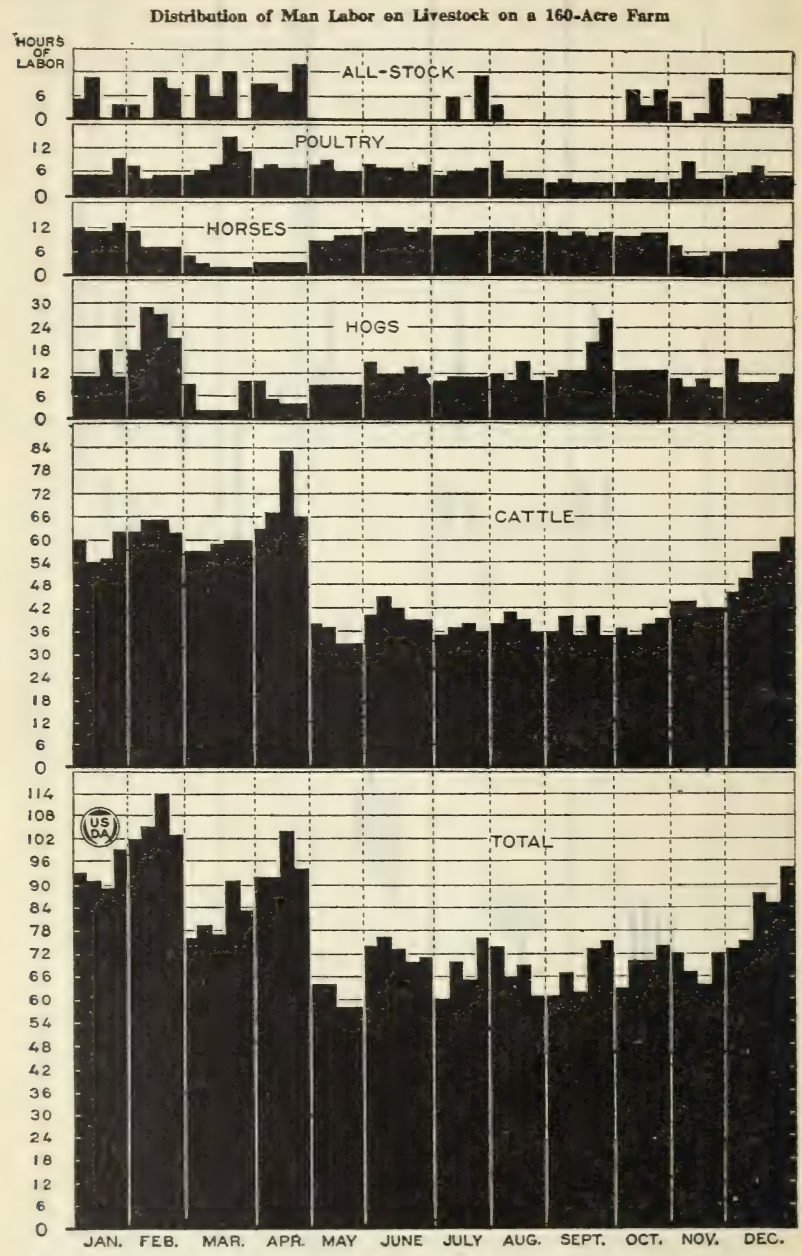

FIG. 22.—Livestock requires more regular attention throughout the year than crops. During the periods of rush field work in summer the livestock chores are reduced as much as possible

the "all-stock" labor may be shifted into the winter months when there is the least work on crops. The regular chore labor of feeding

and caring for livestock must be done every day regardless of the urgency of crop or other work.

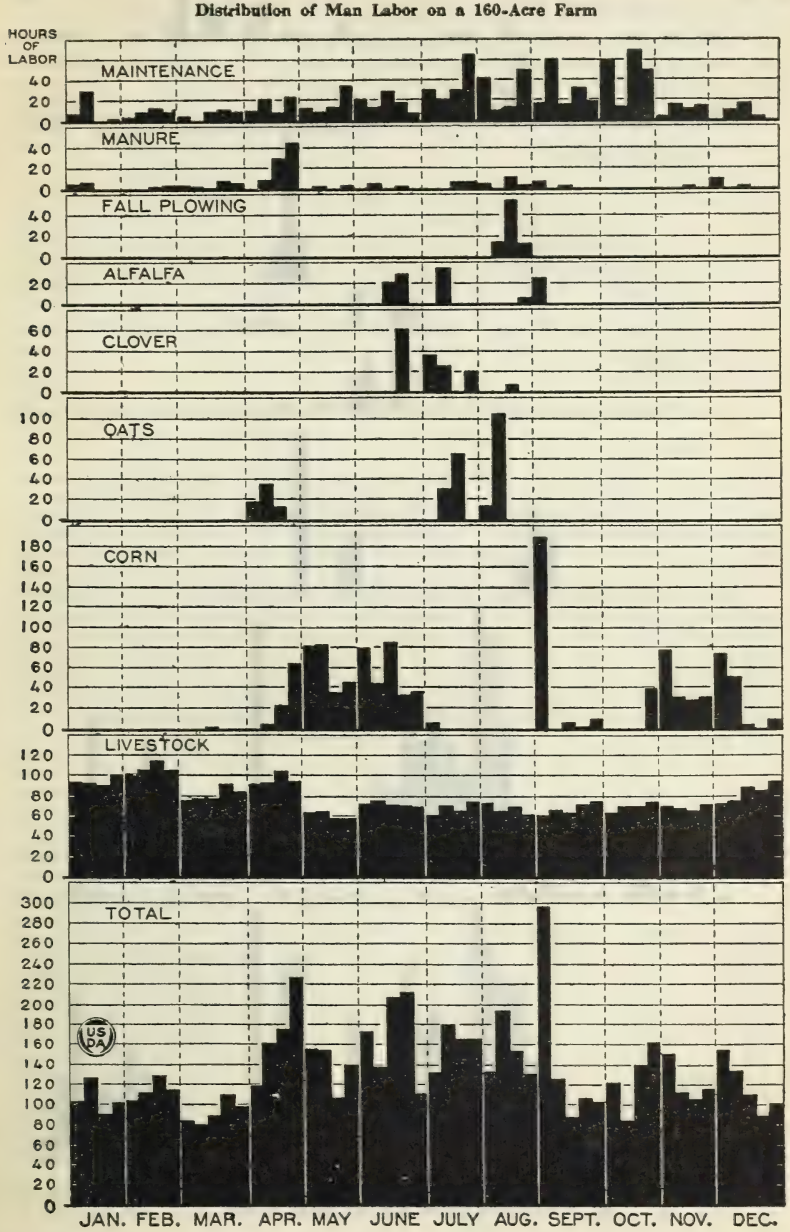

FIG. 23.—The labor program on the diversified farm is made up of the labor on a number of crop and livestock enterprises and other labor of a miscellaneous character. The farmer must consider the time at which the different enterprises require attention in deciding which ones to include in his business

In planning the labor program of the farm it is necessary to combine the crop and livestock enterprises in such a way that the sum of

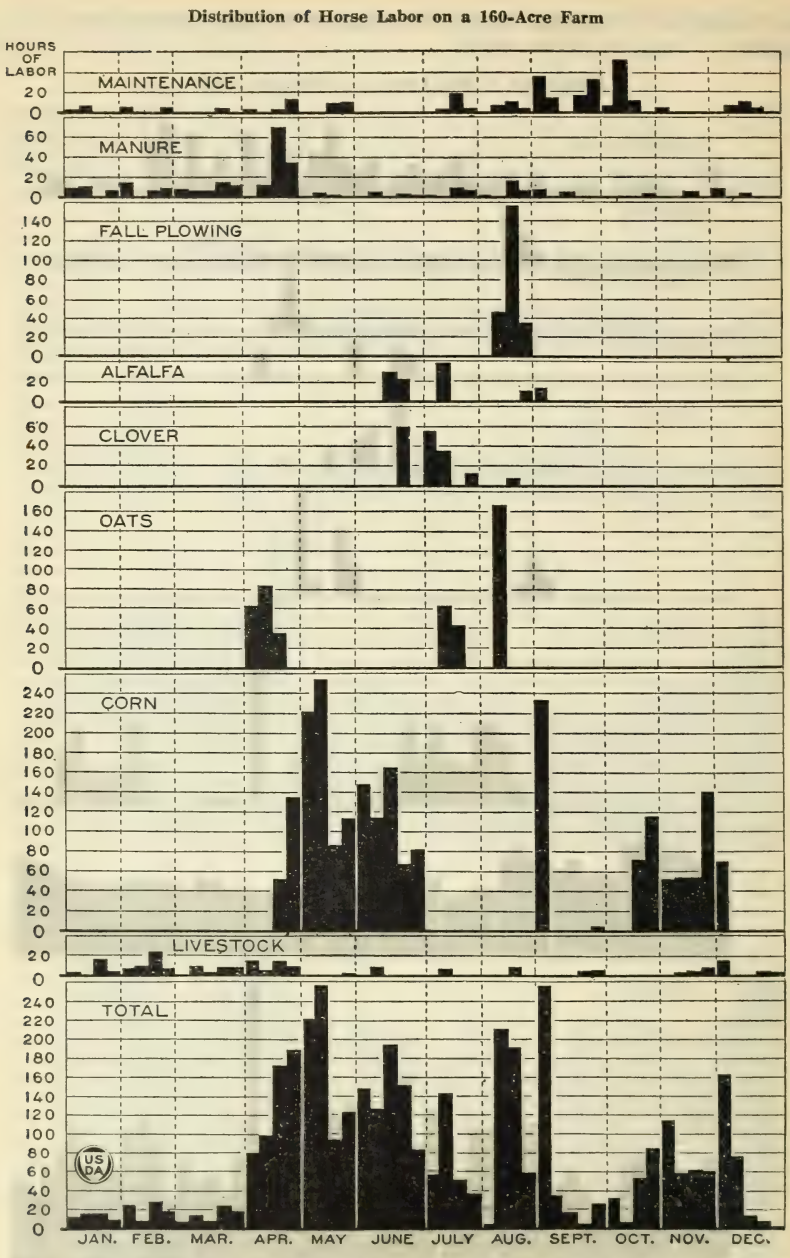

FIG. 24.—There is little work for the horses to do after the corn husking is completed until the work of seed-bed preparation begins in April

the labor expended on them increased by the necessary miscellaneous labor will be so distributed throughout the year as to make the fullest utilization of the available labor supply. Figures 23 and 24 show the

distribution by weeks of all labor on a 160-acre farm in the Windom area.[18]

These charts illustrate the fact that although the labor requirements for each crop are characterized by peak demands at certain periods, the whole cropping plan is so adjusted that the peaks of different crops never coincide. During the second and third weeks in June there is a peak in the total man labor caused by the coincidence of high labor demands of three different crops. The lower livestock labor requirements during the summer are more than offset by the larger amount of crop labor during this season. The result is higher total labor requirements during the crop season.

The distribution of horse work is much less uniform than that of man labor. Man labor is usually so scarce in this region as to be the limiting factor in the farm organization and the labor plan is adjusted to the supply of it rather than to the supply of horse labor. Sufficient horses are kept to handle the peak demands, and even with the best labor distribution that can be planned horses will be working at less than their maximum capacity during most of the year.

DAY-TO-DAY MANAGEMENT OF LABOR

In addition to planning an adjustment of crop and livestock enterprises that will result in a desirable seasonal distribution of labor, the individual farmer must work out from day to day the details of his labor plan. The object of this day-to-day management of the labor program is to reduce to a minimum the interference with the crop or livestock work of a seasonal character that must be done during fairly definite periods. Certain tasks, such as feeding and caring for livestock, must be performed every day without fail. There is no shifting or avoiding this type of work and it can be definitely planned for in advance. For other types of work almost as difficult to shift, the exact dates can not be known in advance. Seed-bed preparation and seeding of oats in the spring are in this class. Some years this field work can be started in March, other years not until the latter part of April. The farmer can predict only a few days in advance when his fields will be in condition to work; once they are ready, however, any delay in starting work will not only result in increased competition for his time later on between oats and corn, but will be attended with risk of reduced yields as a result of later seeding. Each day the farmer must decide what are the most important tasks to be done on that day. As conditions interfere with their performance, attention must be turned to others that are most urgent in view of the changed conditions. A classification according to fixity of time of the various kinds of work performed on these Windom farms is presented in Table 46.

In the day-to-day management of labor the work listed in the first column takes precedence. Next in order comes the work listed in the second column, which is fitted in during its appropriate season after the more pressing tasks have been attended to. The third class of tasks may be done at any time of the year that labor is not demanded for the other classes of work. The farmer who most carefully fits together these three classes of work in accordance with their time fixity will find fewer and less serious peaks in his labor demand and will distribute this demand most uniformly throughout the year.

[18] This is the same farm for which the distribution of livestock labor is presented in Figure 22.

TABLE 46.—*Classification of farm operations from the standpoint of fixity as to time*

Work that must be done at a definite time	Work that may vary within seasonal limits	Work that can be done at any time throughout the year
Spring plowing. Seed-bed preparation. Seeding. Cultivating. Cutting, shocking, and stacking small grain. Shock threshing. Putting up alfalfa and tame hay. Cutting corn and filling silo. Regular care of livestock. Attending livestock sales. Repair and upkeep of equipment in so far as necessary to continue fixed-time operations. Repair of fences where stock break out. Emergency building repairs. Marketing perishable or seasonal products. Returning exchange labor.	Fall plowing. Hauling manure. Putting up wild hay Stack threshing. Husking corn. Hauling feed, bedding, and supplies. Shelling corn. Marketing livestock. Grinding feed. Culling poultry. Ringing pigs. Trimming horses' hoofs. Shearing sheep. Dehorning cattle. Pruning trees. Cleaning up farmstead. Ditching and tiling. Hauling gravel. Road maintenance. Fencing. Putting up ice.	General repair work on harness and machinery. Building repairs. Marketing nonperishable products. Cutting and hauling wood. Breaking colts.

Rain is one of the most serious sources of interference with any labor plan. A day's or even a week's labor program may be completely upset by a sudden shower. The farmer constantly faces the task of adjusting his labor in response to rain interference. Table 47 is a list of tasks at which the farmer can busy himself while it is raining, and another at which he can find employment after the rain stops but before the ground is dry enough to work. The farmer who keeps in mind this classification of tasks, or still better keeps a list of tasks which will give him employment while it is raining or the ground is too wet to work, will be best prepared to adjust his labor plans to weather conditions.

TABLE 47.—*Classification of farm operations from the standpoint of the effect of rain and soil conditions*

Work that can be done while it is raining	Work that can not be done while rain is falling, but can be done while ground is wet	Work requiring dry ground and land dry enough to work
Repairing equipment. Grinding sickles. Indoor repair and alterations on buildings. Shoeing horses and trimming hoofs Cleaning calf pens and hog pens. Culling poultry. Cleaning box stalls. Grinding feed.	Cutting hay or grain. Hauling manure. Shelling corn. Cleaning, grading, and treating seed. Mowing lawn and cutting weeds. Hauling hay, straw, feed, and supplies. Marketing crops and livestock products. Butchering. Dehorning cattle. Breaking colts. Sorting hogs and cattle. Shearing sheep. Fencing. Repairing buildings. Pruning trees. Cleaning up farmstead. Hauling gravel. Storing machinery. Drainage and tiling. Cutting and hauling wood.	All tillage operations. Seeding. Haying operations, except mowing. Shocking, stacking, and threshing grain.

A third classification of labor which will serve as a guide in working out the labor program for a farmer is presented in Table 48.

TABLE 48.—*Classification of farm operations from the standpoint of the effect of frozen ground and snow*

Work that can not be done while ground is frozen	Work that can be done while ground is frozen but free of snow	Work that can be done while ground is covered with snow
All tillage, seeding, and harvesting operations, except corn husking. Setting fence posts. Drainage and tiling. Road maintenance. Hauling gravel. Outdoor concrete construction. Painting buildings.	Husking corn. Storing machinery. Cleaning up farmstead. Picking up deadwood in grove and windbreak. Cutting brush	Hauling manure. Marketing crops, livestock, and livestock products Shelling corn. Cleaning, testing, and grading seeds. Hauling seed, feed and supplies. Grinding feed. Attending sales and livestock breeders' meetings. Breaking colts. Culling chickens. Farm bureau business. Cutting and hauling firewood. Repairing equipment. Indoor repairs and alteration on buildings. Butchering. Pruning trees. Putting up ice.

This sorting of tasks is chiefly valuable where a choice is possible within the classes listed in Tables 46 and 47. For example, in the second column in Table 47 there is an option between cleaning up the farmstead, hauling gravel, and cutting firewood, when the ground

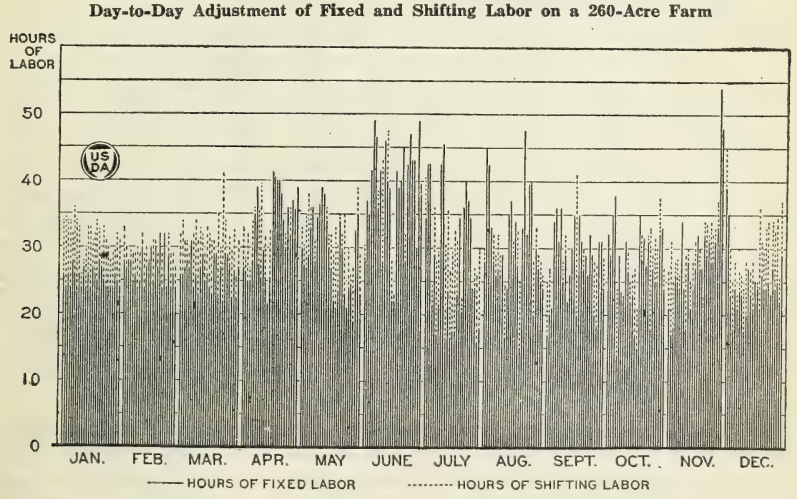

FIG. 25.—Work of a highly seasonal character should be done when the conditions are most favorable for its performance. Work that can be done at any time should not be allowed to delay rush work of a seasonal character

is too wet for field work. If all are of equal importance the farmer should haul gravel, because this must be done before the ground freezes. After the ground is frozen and before the first snow comes, he is confronted with the choice between the two remaining tasks. Cleaning the farmstead should be given precedence because it must

be done before the ground is covered with snow, whereas he can cut wood any time during the winter.

The actual day-to-day adjustment of fixed labor and shifting labor on a 260-acre farm is shown in Figure 25.

In "shifting labor" is included all work listed in columns 2 and 3 in Table 46, except fall plowing, putting up wild hay, stack threshing, and corn husking. These operations are included in "fixed labor." Half of the shifting labor was performed between December 1 and April 15, at a time when there was the least fixed work. The only large amount of shifting labor performed during the busy crop season was during a period of wet weather in May and again between corn cultivation and oat harvest in July. Practically all this shifting labor done in summer was performed during the gaps between fixed operations or when these fixed operations were delayed by weather interference. This represents an excellent adjustment of these two classes of labor from the standpoint of securing a uniform distribution of total labor throughout the year.

EXCHANGE LABOR

In spite of a most careful adjustment of enterprises and a careful day-to-day planning of work there are certain operations, such as

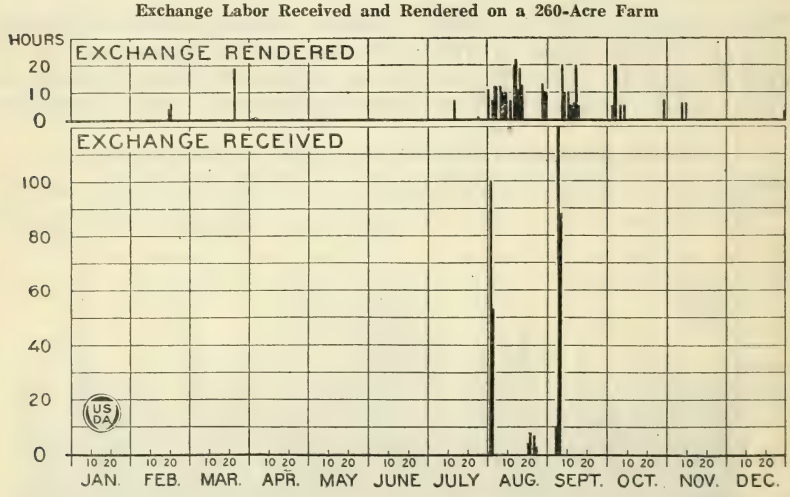

FIG. 26.—By exchanging labor with their neighbors farmers are able to get their small grain threshed and silos filled without hiring large amounts of extra help

threshing and silo filling, that demand for periods of two or three days several times the regular supply of labor available on the farm. To hire this extra labor would be expensive and ordinarily it is not available. The customary way of providing the large supply of labor demanded for these operations in the Windom area is for neighbors to exchange labor with each other. The way this worked out on an individual farm is illustrated in Figure 26. Two hundred and eight hours of labor were required for oat threshing in less than two days. The regular labor on the farm could only be expanded to provide 45 hours per day, but not over 30 hours of this was available for threshing. The additional labor required was furnished by

this man's neighbors. At silo-filling time even less regular labor was available, but as much as 140 man hours were required in one day. Exchange help was received to supply this demand and also in smaller quantities to assist in haying. Three hundred and sixty-eight hours of exchange help was received during the busiest 4 days and 31 hours during the other 5 days. This total of 399 hours was repaid by 401 hours of work rendered these same neighbors but spread over 40 days.

This handling of peak loads by exchange work merely distributes these peaks over a longer period of this time. This farmer distributed the extra requirement for 8 days over 40 days and thus avoided hiring extra labor.

THE PRINCIPLES OF THE CHOICE AND ADJUSTMENT OF CROP AND LIVESTOCK ENTERPRISES

FACTORS AFFECTING CHOICE AND ADJUSTMENT OF ENTERPRISES

Basic data, such as have been presented, may be used in planning a well-balanced farm-organization scheme, with a view to securing the maximum returns from farming. When used in this way, they must of necessity be combined with data on normal yields and normal price trends or probable future prices. The farmer is continually confronted with the problem of apportioning his resources among the different lines of production. He must decide how many acres of the different kinds of crops to grow and the number and kinds of livestock to keep. His objective in organizing his business should be to keep his enterprises adjusted to the conditions of the market in such a manner as to yield maximum results. This adjustment can not be made once for all time. As the expenses of production or the prices of products change readjustments must be made to meet the new conditions.

In the area covered in this discussion, all the land is included in rather clearly defined farm units; consequently the necessary procedure is the adjustment of enterprises to conditions on particular farms and to general price conditions, rather than the choice of farms adapted to definite types of organization. Decisions on individual farms must be made in view of these conditions. In general, farmers are attempting to secure the most profitable utilization of the resources at their command. These resources are real estate (owned or rented), machinery, other equipment, work stock, other livestock, the operator's labor and managerial ability, any regular hired labor employed, and such family labor as is available for farm work.

In determining the combination and proportion of farm enterprises the following characteristics of the problem are important:

(1) The several lines of production of the farms in this locality vary in their demands upon the resources of the farmer.

(2) The succession of a large number of different operations from season to season on the farms in this area necessitates frequent labor adjustments.

(3) Certain nonmarketable resources must be utilized when and where they are available.

(4) The use of intermediate products presents a complicating factor.

The several lines of production on the farms in this locality vary in their demands upon the resources of the farmer.—The different crops

require different amounts of man labor, horse labor, land, and managerial ability for a given volume of product. For example, on 18 farms in 1921 averages of 19 hours of man labor and 42 hours of horse labor per acre were used in the production of corn. On the same farms, averages of 7 hours of man labor and 16 hours of horse labor were used in the production of oats. Likewise, the different kinds of livestock require varying amounts and qualities of labor, feed, shelter, and other requirements.

There are also wide variations in the time at which and the periods during which these various requisites are demanded by the different kinds of crops and livestock. Most crops require attention only at certain definite seasons of the year and these seasons are different for the various crops. For example, the seed-bed preparation and seeding of oats are ordinarily completed several days before the time for final preparation and planting of corn. Then late in July after the corn cultivation is completed comes the oat harvest. Thus the labor, horses, and machinery of the farmer are usually employed more economically in a system of diversified farming than in a single-crop system, even if the crop needing attention at one time gives a lower return than that requiring attention at another time.

On some crops the labor is used in more or less regular amounts over a long productive period. In some cases, notably with the small-grain crops, the work comes in two or three short periods of seed-bed preparation, planting, harvesting, and threshing. Crops which require attention at the same time of the year may be regarded as *competing crops*. The spring grains—oats, barley, and spring wheat—are examples of competing crops in this area. They require about the same amount of man labor, horse labor, and tools at approximately the same time.

One enterprise is *complimentary* to another when it makes a definite contribution to it. Crops and livestock are frequently mutually complimentary, the crops furnishing feed for the livestock and the livestock in turn furnishing fertility for the crops. Complementary relations are evident between legumes and other crops included in a rotation. The legumes help to build up the soil for the production of the other crops in the rotation, and frequently the legumes receive protection from the small grain when used as a nurse crop.

Supplementary enterprises are frequently brought in to reduce the burden of expense of the enterprises supplemented. The supplementary enterprise may reduce the idle time, idle land, idle machinery, etc., left over after the major enterprises have been properly conducted. The object is always to get the fullest utilization of the requisites of production, and since such an enterprise utilities supplies of labor and nonmarketable feeds which would otherwise be wasted, it may give a relatively low return and still be profitably included in the farm organization.

The demands of different crops and kinds of livestock frequently conflict in certain respects, although they are complementary or supplementary in other respects. Corn and alfalfa compete for labor during corn cultivation in June and frequently again at silo-filling time. However, the silage and alfalfa are supplementary as dairy feeds and this may more than compensate for the conflicting demands for labor. These conflicting, complementary, and supplementary relationships of enterprises are not susceptible of exact measurement.

However, their importance in obtaining the most profitable utilization of the resources of a particular farm is obvious.

The succession of a large number of different operations from season to season on the farms in this area necessitates frequent labor adjustments.—The operations on a general farm, unlike those of a factory, are not standardized and can not be reduced to routine. The succession of a large number of different operations from season to season renders any general plan of division of labor, specialization by tasks, standardization of operations, etc., practically impossible. These different operations require different conditions as to soil, weather, climate, etc. Thus, it is possible to perform certain of the operations when weather or other conditions are unfavorable for the performance of others. In this way some of the difficulties due to encountering constantly the exigencies of weather in farm work are eliminated. For example, a heavy rain in June may stop corn cultivation for a time. Meanwhile the work of mowing hay may proceed with very little interference. This characteristic must be kept in mind both in the organization and day-to-day management of resources.

Certain nonmarketable resources must be utilized when and where they are available.—At various stages in the conduct of their business the farmers in Cottonwood and Jackson Counties find themselves in possession of certain nonmarketable feeds, nontillable pasture, and idle time of man and horses. These are worth just what the operator can make them add to the value of the product of the farm by proper utilization. A noteworthy example of this is found in the case of the labor supply on many of these farms. When the crop labor constitutes the major portion of the farm work, there is generally a surplus of labor during the winter months when little crop work can be done. Unless an enterprise is introduced which will provide productive employment during these months this labor will be wasted. Such labor may get a lower return than that spent on the major enterprises, but nevertheless the total returns of the farm will be increased by making the best use of it possible.

Similarly, on many of these farms there are supplies of corn stover, skim milk, straw, wild hay, or other frequently nonmarketable feeds, which must be used on the farm in connection with other feeds or allowed to go to waste. The existence of a large amount of nontillable pasture may justify the keeping of livestock which give a relatively low return, but which afford the best market for this particular resource.

The use of intermediate products presents a complicating factor.—In the system of general stock and grain farming common to this region, intermediate products appear at various stages in the production process. This requires decisions on the matter of using these intermediate products in further production or marketing them directly. Thus a producer of hogs who grows his own feed must decide whether the corn, oats, and other feeds are to be sold on the market or through the hogs. The milk or butterfat producer must make similar decisions. The conduct of these livestock enterprises constitutes a method of marketing the products of other enterprises.

Such decisions are rendered more difficult by reason of the effect of the fertility by-product from marketing these feeds through livestock. The value of this fertility added to the soil depends upon the

increase in value of the future product of the soil, and it is therefore impossible to evaluate accurately this fertility by-product of livestock. Wherever livestock constitute an important part of the farming business, due consideration must be given to the matter of producing such feeds as can be produced more economically than they can be purchased.

STATEMENT OF THE PRINCIPLE OF CHOICE

Any one or all of the above-mentioned characteristics of farm organization problems may be present on particular farms. The problems are frequently complex and can not be solved by some simple formula.

Having in mind these characteristics of the problems on his particular farm, the operator should choose such enterprises and in such proportions as can be combined into a well-rounded organization that will give him the best return for his supply of labor, land equipment, and managerial ability.

This is usually accomplished by choosing the one or more major enterprises that will add most to the net returns, and then supplementing the organization with such other enterprises as will give a fuller utilization of the factors and procure a return sufficient to reward the operator for the additional managerial effort put forth.

GENERAL PLAN OF APPLICATION OF THE PRINCIPLES OF CHOICE AND ADJUSTMENT OF ENTERPRISES

The following illustrations are intended to point out how these data may be used in reaching a solution of such problems on two of the farms from which the data were collected. In these illustrations it is assumed that these farmers are attempting to secure the highest returns for the supplies of labor, land, livestock, work stock, machinery, managerial ability, and other resources under their control.

The first step in these illustrations is a description of the resources of these farmers and an analysis of their present organization. The labor and material requirements for the enterprises on these farms are adapted from the data on "Unit requirements of labor and materials for crops and livestock." The returns from the present organization are estimated on the basis of ordinary yields and relative prices of the different products. Comparisons are made between the results secured from the present organization and the probable results from proposed organizations.

In making these comparisons between organizations, it is also necessary to determine the differences in costs of extra hired labor, seed, twine, and other materials which do not constitute a part of the regular supply of resources. This analysis is based on the theory that when choice of enterprises is the objective, only those costs and returns which will be affected by the choice need be considered.[19] Thus adjustments in the cropping system or the kinds of livestock being kept may usually be considered without regard to the question of overhead expenses, land rent, or other charges which are not altered by the choice. The effect of the choice upon the maintenance of soil fertility and the general longtime plan of farming which can

[19] For a further elaboration of this point, the reader is referred to "The objectives in agricultural cost accounting" by Dr. H C. Taylor, Journal of Farm Economics. vol. V no. 2, 1923.

not be radically altered from year to year must, of course, be kept in the mind when making these choices. At the same time this general plan should provide an element of flexibility that will facilitate the making of desirable adjustments as conditions change.

ILLUSTRATION NO. 1

Inventory of resources and present productive organization.—Table 49 gives the resources and productive organization as they existed in 1922 on one of the farms for which data have been presented under "unit requirements." Normal rather than actual crop yields are used in order to avoid the effect of seasonal variations in individual crop yields upon the total amount of crops available for feed and sale. The actual livestock production is presented.

TABLE 49.—*Present cropping system*

Real estate and crops	Acres	Expected yield per acre	Total production
Corn for grain	39	45 bushels	1,755 bushels.
Corn for fodder	9	2 tons	18 tons.
Oats	50	42 bushels	2,100 bushels.
Barley	12	25 bushels	300 bushels.
Rye	6	18 bushels	108 bushels.
Clover and timothy	12	1.5 tons	18 tons.
Alfalfa hay	5.7	3.5 tons	20 tons.
Wild hay	1.8	1.0 tons	1.8 tons.
Total crop area	135.5		
Pasture	43		
Farmstead	6		
Total farm area	184.5		

The buildings are sufficient to take care of 12 cows, 24 young cattle, the work stock, 12 sheep, and 18 brood sows and their pigs.

Productive livestock, number, kind, and production:
12 cows, 2,400 pounds butterfat.
24 young (dairy and miscellaneous) cattle, 8,000 pounds beef.
18 brood sows, 20,000 pounds pork.
12 sheep, 100 pounds of wool, 650 pounds mutton.
Labor supply:
Man-labor—
The labor of the operator for the entire year.
A hired man employed from March to August, inclusive.
The operator's wife, who assisted with the care of dairy utensils.
Horse labor: Six horses throughout the year.
Machinery and equipment: The farm is fully equipped with the machinery needed in the production of small grain, corn, and hay crops.

The distribution of man and horse labor on this farm by weeks for 1922 is shown in Figure 27. The supply of each available for use on the different enterprises is shown by the dotted lines on the chart.

Strictly speaking, the supply of regular man labor is rather flexible because of the speeding up or lengthening of the day during periods of heavy demand for labor. This speeding up is usually followed by a corresponding decline in the amount of work done during the following period. The supply as shown in the chart was estimated by taking the usual full day's work performed by the regular laborers on this farm and assuming that this could be maintained throughout the season. All labor other than that done by the operator and his wife must be hired.

The first important peak of man labor was during April and early May. The preparation and seeding of the oats and barley crops

were largely responsible for this peak. After this peak there was a surplus of labor throughout the remainder of the time that the hired man was kept. In October, November, and early December corn husking is responsible for a piling up of labor. Much of this work is ordinarily handled by special labor paid for on the basis of bushels husked, and the actual time required is therefore not so important to the operator.

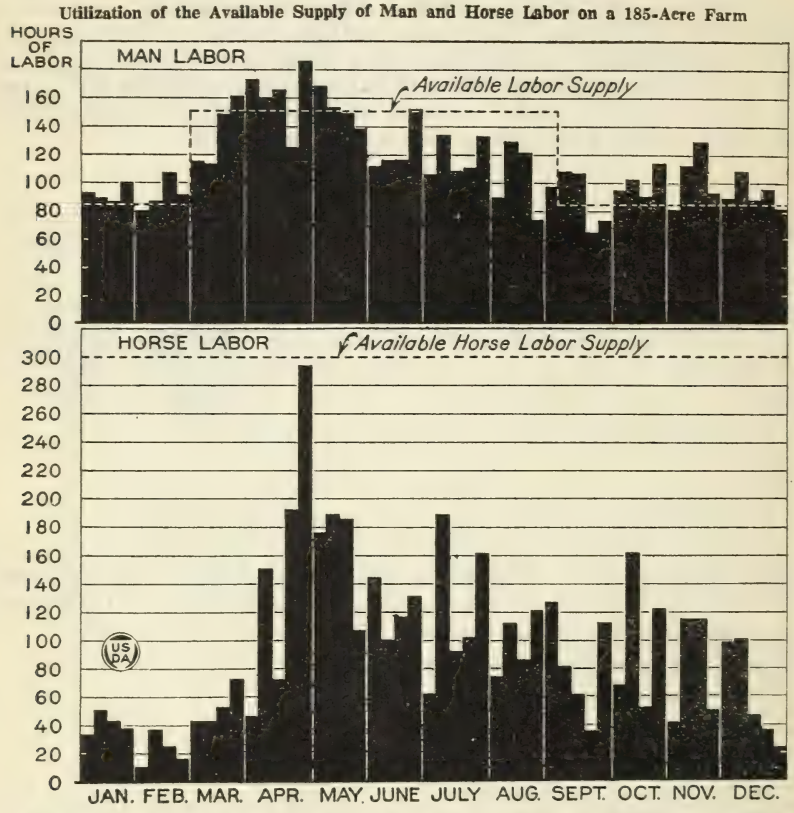

FIG. 27.—The crops and livestock produced on the farm should be chosen with a view of providing the farmer with the most profitable means of using his time and equipment in farming. The returns from farming are usually higher when the farm enterprises provide regular employment for the farmer's time and equipment

The distribution of horse labor on this farm by weeks, as well as the available supply, is shown in Figure 27. Horses are not a limiting factor in the organization of the farms of this area.

Yields and relative prices used in making calculations for the future.—In making plans for the future, calculations must be based upon the probable yields of the different products and the prices which may be obtained when the products are ready for sale. The yields presented in table 49 are the estimated normal yields for this farm. In making calculations the best current information available concerning the probable prices of different products should be used. The following local market prices for crops and livestock products prevailing in the

locality in 1922 for the grade of product produced by this farmer are used in this illustration:

Corn	per bushel	$0.50	Pork	per pound	$0.08
Oats	do	.30	Beef	do	.05
Barley	do	.40	Wool	do	.30
Rye	do	.70	Mutton	do	.10
Butterfat	per pound	.45			

Unit requirements of labor, materials, and feeds in the production of crops and livestock.—Reasonable requirements for crop production on this farm, based upon the amount of labor used for different operations in 1920, 1921, and 1922, and upon a comparison of these amounts with standards previously set forth are shown in Tables 50 and 51. These requirements are based upon the actual requirements for three years on this farm and may be considered as normal requirements for the conditions obtaining as to size of implements and teams used, size of fields, and other variable factors.

TABLE 50.—*Normal labor requirements per acre of crops*

Operation	Man hours	Horse hours	Times over	Operation	Man hours	Horse hours	Times over
Seed-bed preparation operations:				Barley operations—Con.			
Plowing	2.50	10.00		Cutting	0.82	3.28	
Disking	.56	2.24		Shocking	1.10		
Harrowing	.28	1.12		Threshing	3.00	5.00	
Corn operations:				Wild hay:			
Plowing	2.50	10.00		Mowing	1.67	3.34	
Disking	.84	3.36	1.5	Raking	.83	1.66	
Harrowing	.68	2.72	2.5	Hauling and stacking	4.00	5.56	
Planting	.81	1.62		Alfalfa:			
Cultivating	4.00	8.00	3.0	First cutting—			
Husking	7.25	14.00		Mowing	1.20	2.40	
Fodder corn:				Raking	.50	1.00	
Cutting	1.71	5.13		Hauling	5.00	6.00	
Shocking	4.00			Second cutting—			
Oats operations:				Mowing	.88	1.76	
Disking	1.12	4.48	2.0	Raking	.50	1.00	
Harrowing	.28	1.12	1.10	Hauling	3.00	4.00	
Seeding	.52	2.08		Third cutting—			
Cutting	.82	3.28		Mowing	.70	1.40	
Shocking	1.10			Raking	.40	.80	
Threshing	3.00	5.00		Hauling	2.00	2.50	
Barley operations:				Clover and timothy hay:			
Plowing	2.50	10.00		Mowing	1.25	2.50	
Harrowing	.56	2.24	2.0	Raking	.50	1.00	
Seeding	.52	2.08		Hauling	2.25	5.50	

TABLE 51.—*Material requirements of crops*

Crop	Seed per acre	Twine per acre	Threshing or husking per bushel
Corn	10 pounds	5.5 pounds	$0.06
Oats	3.2 bushels	3.4 pounds	.03
Barley	2.3 bushels	3.4 pounds	.03
Clover and timothy	8 pounds		
	6 pounds		
Alfalfa	12 pounds		

Feed and labor requirements for livestock production obtained in a similar manner are shown in Table 52.

TABLE 52.—*Feed and labor requirements for livestock*

	Corn	Oats	Skim Milk	Whole Milk	Tame hay	Alfalfa	Corn fodder	Wild hay	Veterinary and medicine	Hours of labor	
										Man	Horse
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Dollars*	*Hours*	*Hours*
Per horse	1,680	1,600	------	------	5,000	------	------	600	1.00	60	------
Per cow	800	1,200	------	------	500	2,500	1,000	------	.80	130	52
Per head of miscellaneous cattle:											
0 to 1 year	150	400	1,400	180	750	250	200	------	.60	12	1
1 to 2 years	500	400	------	------	1,200	500	1,200	------	.60	12	1
Per 100 pounds of pork	400	90	125	------	------	------	------	------	.20	3	.2
Sheep	------	40	------	------	40	40	250	------	------	3	.5

The amounts of grain and hay required for beef and butterfat production are higher than the standards set up under "Unit requirements," partly because there was no silo on the farm. The 1 and 2 year old miscellaneous cattle get a larger amount of grain than on most farms in the area.

TABLE 53.—*Returns from present organization*

	Acres	Yield per acre	Total yield	Amount required for feed	Salable surplus	Amount purchased
Corn for grain	39	45 bushels	1,755 bushels	1,955 bushels	------	200 bushels.
Corn fodder	9	2 tons	18 tons	18 tons	------	
Oats	50	42 bushels	2,100 bushels	1,190 bushels	910 bushels	
Barley	12	25 bushels	300 bushels	300 bushels	------	
Rye	6	18 bushels	108 bushels	------	108 bushels	
Alfalfa	5.7	3.5 tons	20 tons	20 tons	------	
Clover and timothy	12	1.5 tons	18 tons	31 tons	------	13 tons.
Wild hay	1.8	1 ton	1.8 tons	1.8 tons	------	

Livestock products:		Crop sales:	
20,000 pounds pork, at $0.08	$1,600	910 bushels oats, at $0.30	$273
8,000 pounds beef, at $0.05	400	108 bushels rye, at $0.60	65
2,400 pounds butterfat at $0.45	1,080	Total crop sales	338
100 pounds wool, at $0.30	30		
650 pounds mutton, at $0.10	65	Total livestock and crop sales	3,513
Total livestock sales	3,175		

COST OF EXTRA MATERIALS AND THRESHING FOR THIS ORGANIZATION

	Seed	Twine	Threshing or husking	Total
Corn	$13.00	$6.00	$105.00	$124.00
Oats	48.00	20.00	63.00	131.00
Barley	11.00	5.00	9.00	25.00
Rye	6.00	1.00	6.00	13.00
Clover and timothy	13.00	------	------	13.00
Alfalfa	6.00	------	------	6.00
Total	97.00	32.00	183.00	312.00
Veterinary, medicine, and livestock:				
Swine	------	------	------	$40.00
Cows	------	------	------	10.00
Miscellaneous cattle	------	------	------	15.00
Horses	------	------	------	6.00
				71.00
Total materials for crops and livestock	------	------	------	383.00
Corn purchased for feed	------	------	------	100.00
Hay purchased for feed	------	------	------	130.00
Total extra costs	------	------	------	613.00
Total returns to organization after deducting extra material costs	------	------	------	2,900.00

THE WEAKNESSES OF THE PRESENT ORGANIZATION AND THE SUGGESTIONS FOR REORGANIZATION

Although this organization is one of the better types found among the farms studied, certain weaknesses are apparent. A definite rotation of crops including legumes for hay and maintenance of soil fertility has not been developed. This seems desirable from the standpoint of long-time profits and of producing sufficient hay on the farm for the livestock being kept. The small grain acreage is out of proportion to the corn acreage from the standpoint of production of feed for livestock and balanced rotation of crops.

The acreage of corn and tame hay can be increased without hiring any additional labor or increasing the number of work stock. The amount of pork produced was low in proportion to the amount of skim milk available for use. More pork could be produced without increasing the number of brood sows by raising fall litters as was done one year on this farm, but this would necessitate the production or purchase of more corn.

In order to show how changes in the organization of this farm would affect the returns, changes in the cropping system are suggested in reorganization plan No. 1.

REORGANIZATION PLAN NO. 1

Effect of a change in the cropping plan upon the returns.—This reorganized cropping plan involves a reduction in oat production of 8 acres and the elimination of the 12 acres of barley and 6 acres of rye. Seventeen additional acres of corn and 8 additional acres of clover and timothy are grown. This change provides more feed for livestock. The net returns from salable crops are slightly reduced, but the reduction in extra material costs more than balances this decrease. The effect of these changes on the returns from the farm as compared with the present organization is outlined in Table 54.

This plan of operating the farm requires 4,500 hours of regular crop and livestock chore labor. In addition to this, 900 hours of miscellaneous crop and livestock labor and maintenance labor are required. The distribution of that regular crop and livestock labor was estimated by using the data on requirements by operations in Tables 50 and 52 and the usual dates of performance given under "Unit requirements." The probable distribution of this regular labor on crops and livestock is shown in Figure 28. In actual practice it is of course very common for the program to be shifted forward or backward a short period, but the sequence of the work on the different crops usually remains in about the same relative position from year to year. Thus, as a late season delays the seeding of oats, it will also delay the corn work and most of the entire program will usually come later in the same relative position with respect to the other work.

Figure 28 also shows the available supply of labor. Approximately 1,600 hours of available time are well distributed throughout the year for the performance of the miscellaneous crop and livestock work incident to this organization. As already brought out, it is good management on the part of the farmer to fit in this type of work when the weather or other conditions are unfavorable for the per-

TABLE 54.—*Proposed cropping system*

	Acres	Yield per acre	Total yield	Amount required for feed	Salable surplus	Amount purchased
Corn for grain	56	45 bushels	2,520 bushels	1,954 bushels	565 bushels	
Corn fodder	9	2 tons	18 tons	18 tons		
Oats	42	42 bushels	1,764 bushels	1,640 bushels	124 bushels	
Clover and timothy	20	1.5 tons	30 tons	31 tons		1 ton.
Alfalfa	5.7	3.5 tons	20 tons	20 tons		
Wild hay	1.8	1.0 tons	1.8 tons	1.8 tons		

Sales:	
Crops—	
565 bushels corn at $0.50	$283
124 bushels oats at $0.30	37
	320
Livestock products (same as present organization)	3,175
Total livestock and crops	3,49

COSTS OF SEED, TWINE, AND OTHER MATERIALS

	Seed	Twine	Threshing or husking	Total
Corn	$17	$6	$151	$174
Oats	40	17	53	110
Clover and timothy	21			21
Alfalfa	6			6
Total	84	23	204	311
Veterinary, medicine, etc. (same as present organization)				71
Total				382
Hay purchased for feed				10
Total extra materials costs				392
Total returns to organization after deducting extra material costs				3,103
Net increase over present plan of operation				203

formance of work of a seasonal character. The proper day-to-day management of resources is essential if any organization plan is to be efficiently carried out. With all of the time available in this case there is very little possibility of any extra labor being necessary to conduct this organization. This plan requires no additional labor except that for which provision has been made in the increased cash allowance for corn husking. The labor is more uniformly distributed throughout the year and the probable necessity of hiring extra labor in the spring is reduced. There is a wider margin of safety between the provision of feeds and the requirements for livestock. No change in resources is involved.

Effect of changes in the prices of beef and butterfat upon the choice between these enterprises.—Frequently the influence of changes in the relative prices of different products suggests a shift in the emphasis on the different lines of production. This may be illustrated by assuming changes in the prices of beef and butterfat from those given on page 85. By reducing the number of young cattle to 20, this farmer could keep 2 more cows on practically the same amount of feed. The cows would require more labor, but not any

more than is already available from the regular supply. The results of this change would be as follows:

400 pounds more butterfat produced, at 45 cents	$180
2,000 pounds less beef produced, at 5 cents	100
Added returns from the choice of butterfat production	80

Assuming the price of beef to be 7 cents per pound and the price of butterfat only 30 cents, the result would be as follows:

2,000 pounds less beef, at 7 cents	$140
400 pounds more butterfat, at 30 cents	120
Added returns from the choice of beef production	20

In one case the farmer could obtain an increase of $80 if he considered that sufficient to repay him for the additional 212 hours of labor involved. In the other case, he would actually reduce his returns by expanding the dairy at the expense of the beef enterprise. The nature of the cattle enterprise on most of the farms in this area is such as to permit taking advantage of the changes in the relative prices of beef and butterfat.

REORGANIZATION PLAN NO. 2

Effect of an increase in size of business upon the returns.—It is obvious from a comparison of the weekly distribution of labor and the available supply of labor as shown in Figures 27 and 28 that with the exception of the corn husking period there is considerable room for expansion without necessitating the hiring of any additional labor. In order to have a better balanced organization and to obtain a fuller utilization of his resources, this farmer rented 30 acres of additional land during one year of this study. This land was used for grain production and two-fifths of the yield was paid as rent. The possibilities of obtaining a fuller utilization of the man and horse labor and of providing feed for the expansion of the hog enterprise are shown below.

In these estimates the same requirements for the different enterprises are used as for the previous smaller organization. As a matter of fact, this is not what usually happens under actual farm conditions. The extent to which expansion means greater or less efficiency in the conduct of the different enterprises depends upon the ability of the operator to manage additional units. There was no significant change in the rate of performing the various crop operations on this farm as a result of expansion.

The 30 additional acres of land is distributed as follows under this second reorganization plan: Corn, 14 acres; oats, 8 acres; clover and timothy, 5 acres; pasture, 2 acres; and corn fodder, 1 acre. There is no change in livestock except the increase of pork production to 30,000 pounds by raising fall litters from part of the brood sows. The same feed requirements per 100 pounds for pork production have been assumed. The outline given in Table 55 indicates the return from this reorganization.

This expansion of the business involves no change in resources but requires approximately 750 additional hours of man labor. Of this, 225 is for corn husking which has been covered in a cash allowance for husking so the net increase is only 525 hours. On account of the

better seasonal distribution of labor this could ordinarily be handled by the present supply of labor by a slight increase in length of working

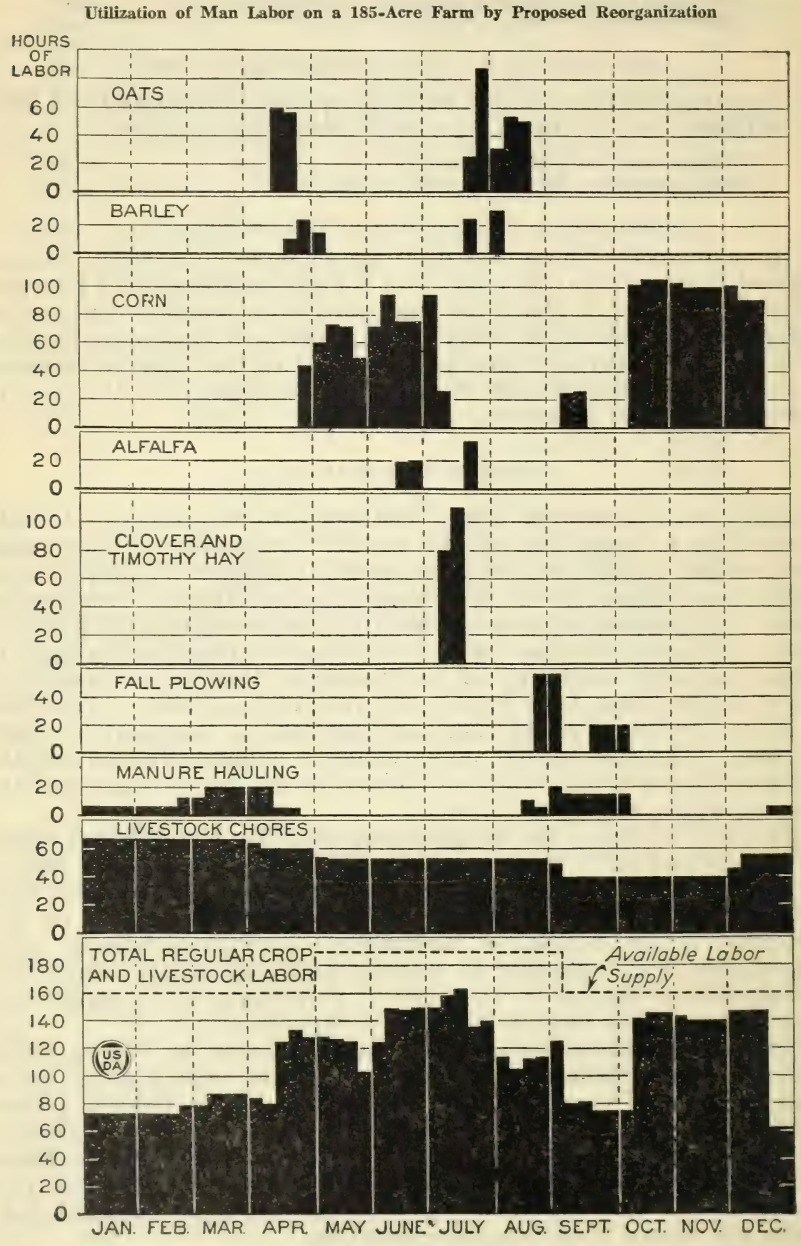

FIG. 28.—In planning the farm organization, the distribution of the labor on the different enterprises is of prime importance

day at certain periods. Only in case of a piling up of different kinds of work as the result of an unfavorable season or other unforeseen emergency would it be necessary to hire extra labor. A careful

day-to-day management of the labor program would help materially in avoiding the necessity of hiring extra labor at any time. This plan greatly reduces the possibility of shortage of feed for the livestock being kept, and at the same time gives a net increase in returns of nearly $700 over the present plan of operation.

TABLE 55.—*Returns from reorganization plan No. 2*

	Acres	Yield per acre	Total yield	Amount required for feed	Amount for rent	Salable surplus
Corn for grain	70	45 bushels	3,150 bushels	2,650 bushels	324 bushels	176 bushels.
Corn fodder	10	2 tons	20 tons	All		
Oats	50	42 bushels	2,100 bushels	1,900 bushels	200 bushels	
Clover and timothy	25	1.5 tons	37.5 tons	All		
Wild hay	1.8	1 ton	1.8 tons	All		
Alfalfa	5.7	3.5 tons	20 tons	All		
Total	162.5					
Pasture	45					
Farmstead	7					
Total	214.5					

Sales:	
Crops—176 bushels corn, at $0.50	$88
Livestock—	
30,000 pounds pork, at $0.08	$2,400
8,000 pounds beef at .05	400
2,400 pounds butterfat at .45	1,080
100 pounds wool at .30	30
650 pounds mutton at .10	65
Total livestock	3,975
Total crops and stock	34,063

COSTS OF EXTRA MATERIALS

	Seed	Twine	Threshing and husking	Total
Corn	$22	$7	$189	$218
Oats	48	20	63	131
Clover and timothy	27			27
Alfalfa	6			6
Total	103	27	252	382
Veterinary and medicine:				
Hogs				60
Cows				10
Miscellaneous cattle				15
Horses				6
				91
Total extra costs				473
Total returns to organization after deducting extra material costs				3,590
Net increase over present plan of operation				690

ILLUSTRATION NO. 2

Inventory of resources and present production organization.—Table 56 gives a description of the resources and productive organization in 1922 of another of the farms studied. This is one of the largest farms in the group and is operated almost altogether by family labor. Normal rather than actual crop yields are used.

TABLE 56.—*Present cropping system*

Real estate and crops	Acres	Yield	Total production
Corn and grain	85	40 bushels	3,400 bushels.
Corn fodder	11	2 tons	22 tons.
Oats	77	38 bushels	2,926 bushels.
Barley	15	25 bushels	375 bushels
Timothy and clover	34	1¾ tons	59 tons.
Alfalfa	5	3 tons	15 tons.
Total	227		
Pasture	81		
Farmstead and lanes	9		
Total farm area	317		

The buildings are equipped for keeping 20 cows and their calves, 8 horses, and 15 hogs for breeding purposes and their pigs.

Productive livestock:

14 cows and their calves ..... 1,750 pounds butterfat.
36 head 1 and 2-year-old cattle ..... 15,000 pounds beef.
10 brood sows ..... 7,500 pounds pork.

Labor supply:

Man labor—

The operator for the entire year.
A 19-year-old son for the entire year.
A 14-year-old son for chores during winter and full time from May to August, inclusive.
The operator's wife assists with dairy utensils throughout the year and with dairy chores during the crop season.

Horse labor—8 horses for the entire year.

Machinery—The farm is fully equipped with machinery for the production of corn, hay, and small grain.

The weekly distribution of man labor for this organization and the supply of labor available for use are shown in Figure 29. The demand for labor exceeds the supply at three different times during the year. In early June the cultivation of corn was responsible for a slight peak requiring three days of extra hired labor. Ten days of extra labor were necessary for the harvest of oats and barley in July. Again in November extra hired labor was used for corn husking. However, a part of this work might have been done by the regular labor supply had it been allowed to wait until later in the season. A relatively high yield of corn was partly responsible for the peak of labor during October and November.

Prices used in making calculations for the future.—The following are the 1922 prices of the crops and livestock products produced on this farm. These will be used in calculating returns from proposed plans for reorganization: Corn, 50 cents per bushel; oats, 30 cents per bushel; barley, 40 cents per bushel; rye, 70 cents per bushel; timothy and clover hay, $10 per ton; butterfat, 45 cents per pound; beef, 6 cents per pound; [20] pork, 8 cents per pound.

The normal requirements of labor, feed, and other materials for crop and livestock production on this farm were determined by

[20] This price is higher than that used in the previous illustration because a more finished product is marketed.

comparing the standard requirements with those of this farm for three years. These are shown in Tables 57, 58, and 59.

Utilization of the Available Supply of Man Labor on a 317-Acre Farm

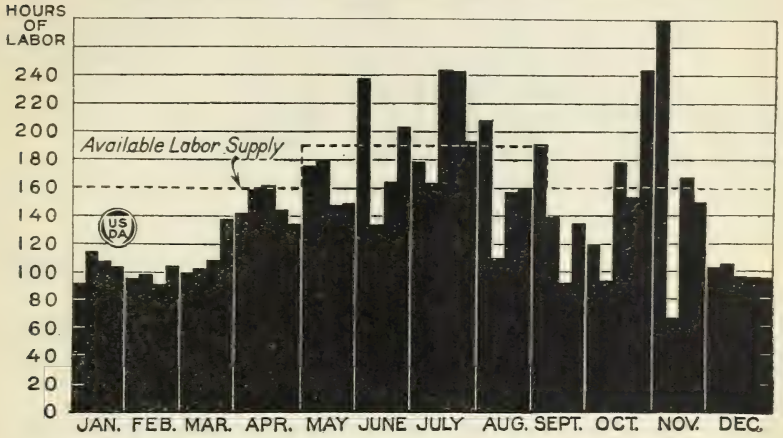

FIG. 29.—The labor supply is frequently expanded by working longer hours. However, there are usually rush seasons on most farms when extra help must be hired or exchanged

TABLE 57.—*Normal labor requirements for crop production on this farm*

	Hours of labor		Times over		Hours of labor		Times over
	Man	Horse			Man	Horse	
Seed-bed preparation:				Barley operations:			
Plowing	2.15	8.60		Plowing	2.15	8.60	
Disking	.55	2.20		Harrowing	.60	2.40	2.0
Harrowing	.30	1.20		Seeding	.50	2.00	
Corn operations:				Cutting	.60	2.40	
Plowing	2.15	8.60		Shocking	1.00		
Disking	.90	3.60	1.6	Threshing	2.00	3.50	
Harrowing	.75	3.00	2.5	Timothy and clover:			
Planting	.62	1.24		Mowing	1.00	2.00	
Cultivating	3.75	7.50	3.0	Raking	.60	1.20	
Husking	10.00	16.00		Haul and stack	4.00	5.00	
Fodder corn:				Alfalfa:			
Cutting	1.65	4.95		First cutting—			
Shocking	3.00			Mowing	1.25	2.50	
Oat operations:				Raking	.75	1.50	
Disking	1.10	4.40	2.0	Haul and stack	4.50	5.00	
Harrowing	.30	1.20	1.0	Second cutting—			
Seeding	.50	2.00		Mowing	1.00	2.00	
Cutting	.80	3.20		Raking	.67	1.34	
Shocking	1.00			Haul and stack	4.00	5.00	
Shock threshing	2.00	3.50					

TABLE 58.—*Material requirements of crops*

	Seed per acre	Twine per acre	Thrashing per bushel
Corn	9 pounds	6 pounds	
Oats	3.2 bushels	2.6 pounds	$0.03
Barley	2.4 bushels	2.6 pounds	.04
Rye	1.6 bushels	1.7 pounds	.07
Alfalfa	12 pounds		
Clover	8 pounds		
Timothy	6 pounds		

TABLE 59.—*Feed and labor requirements for livestock*

Unit	Corn	Small grain	Alfalfa hay	Clover and timothy hay	Corn fodder	Skim milk	Whole milk	Veterinary, medicine	Labor	
									Man	Horse
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Dollars*	*Hours*	*Hours*
Per horse	1,680	2,000	------	6,000	------	------	------	0.50	50	------
Per cow	1,000	500	1,500	1,000	1,000	------	------	.35	120	7
Per head miscellaneous cattle:										
0 to 1 year	150	75	400	400	100	1,250	400	.10	10	.5
1 to 2 years	750	500	100	1,000	750	------	------	.10	10	.5
Per 100 pounds pork	400	80	------	------	------	160	------	.20	3	.4

TABLE 60.—*Returns from present organization*

	Acres	Yield per acre	Total yield	Amount required for feed	Salable surplus
Corn for grain	85	40 bushels	3,400 bushels	1,540 bushels	1,860 bushels.
Oats	77	38 bushels	2,926 bushels	1,235 bushels	1,690 bushels.
Barley	15	25 bushels	375 bushels	175 bushels	200 bushels.
Alfalfa	5	3 tons	15 tons	All	
Clover and timothy	34	1¾ tons	59 tons	51 tons	8 bushels.
Corn fodder	11	2 tons	22 tons	All	

Crop sales:	
1,860 bushels corn, at $0.50	$930
1,690 bushels oats, at $0.30	507
200 bushels barley, at $0.40	80
8 tons hay, at $10	80
Total crop sales	1,597

Livestock products:	
1,750 pounds butterfat, at $0.45	$788
15,000 pounds beef, at $0.06	900
7,500 pounds pork, at $0.08	600
Total livestock sales	2,288
Total crop and livestock sales	3,885

COST OF EXTRA MATERIALS AND THRESHING FOR THIS ORGANIZATION

	Seed	Twine	Threshing	Total
Corn	$24.00	$8.00	------	$32.00
Oats	74.00	24.00	$81.00	179.00
Barley	14.00	5.00	15.00	34.00
Clover and timothy	36.00	------	------	36.00
Alfalfa	5.00	------	------	5.00
Total	153.00	37.00	96.00	286.00
Veterinary and medicine:				
Cows	------	------	------	5.00
Young cattle	------	------	------	5.00
Hogs	------	------	------	15.00
Horses	------	------	------	4.00
Total	------	------	------	29.00
Extra hired labor	------	------	------	31.00
Total costs of extra labor and materials	------	------	------	346.00
Returns to the organization after deducting costs of extra labor and materials	------	------	------	3,539.00

This organization, consisting largely of corn, small grain, and mixed cattle enterprises, is a type common in this area. It is also typical of a number of farms included in this study, in that there is a relatively abundant supply of family labor for farm work. This farm is well organized for crop production, but these crops are not efficiently marketed through the livestock. Only 125 pounds of butterfat were produced per cow, and the beef produced is low in comparison with the feeds consumed. The hog enterprise might well be expanded. Here the possibility of improvement in the organization depends largely upon the ability of the operator to improve the livestock enterprises.

REORGANIZATION PLAN NO. 1

Effect of an adjustment of the crop acreages upon returns.—The first plan for reorganization provides for a change in the relative amounts of corn and small grain with a view to increasing the salable product and reducing the possibility of needing extra labor in April and July. Fifteen acres of corn are substituted for a like acreage of oats.

TABLE 61.—*Estimated returns from proposed organization*

	Acres	Yield per acre	Total yield	Amount required for feed	Salable surplus
Corn for grain	100	40 bushels	4,000 bushels	1,540 bushels	2,460 bushels.
Oats	62	38 bushels	2,356 bushels	1,235 bushels	1,120 bushels.
Barley	15	25 bushels	375 bushels	175 bushels	200 bushels.
Alfalfa	5	3 tons	15 tons	All	
Tame hay	34	1¾ tons	59 tons	51 tons	8 tons.
Corn fodder	11	2 tons	22 tons	All	

Farm crops sales:	
2,460 bushels corn, at $0.50	$1,230
1,120 bushels oats, at $0.30	336
200 bushels barley, at $0.40	80
8 tons of hay at $10	80
Total crop sales	1,726
Livestock sales (same as above)	2,288
Total crop and livestock	4,014

COST OF MATERIALS

	Seed	Twine	Threshing	Total
Corn	$27.00	$8.00		$35.00
Oats	60.00	19.00	$71.00	150.00
Barley	14.00	5.00	15.00	34.00
Timothy and clover	36.00			36.00
Alfalfa	5.00			5.00
Total	142.00	32.00	86.00	260.00
Veterinary and medicine				29.00
Total cost of materials				289.00
Returns to the proposed organization after deducting cost of materials				3,725.00
Net increase over present organization				186.00

The distribution of the regular crop and livestock labor for this proposed organization is shown in Figure 30. With this organization there would be required 187 hours more of man labor than are required as the farm is now organized. It is apparent from the chart that this work can be done by the regular supply of labor. Besides the regular crop and livestock work there are 1,500 hours of miscellaneous crop and livestock work to be done. There are approximately 3,000 hours of regular labor available for performing this miscellaneous work and this available time is well distributed throughout the year. There is, of course, the possibility of expanding the supply by lengthening the work day in case of emergencies. When this occurs, farmers usually do not put in such long hours for a while after the rush work is over.

Effect on returns of replacing barley with oats.—The relative position of the oats and barley crops in this organization is significant. The yield per acre of barley on this farm is relatively lower than that of oats. They produce about the same amount of feed per acre. As shown in the chart, most of the seed-bed preparation and seeding of barley comes after the oats have been seeded. This avoids the

necessity of hiring extra labor in order to get the oats in on time. Also additional labor is available in time to assist with the barley work. Again, at harvest time the barley work usually comes just before the oats and fits in well with the labor program. It also

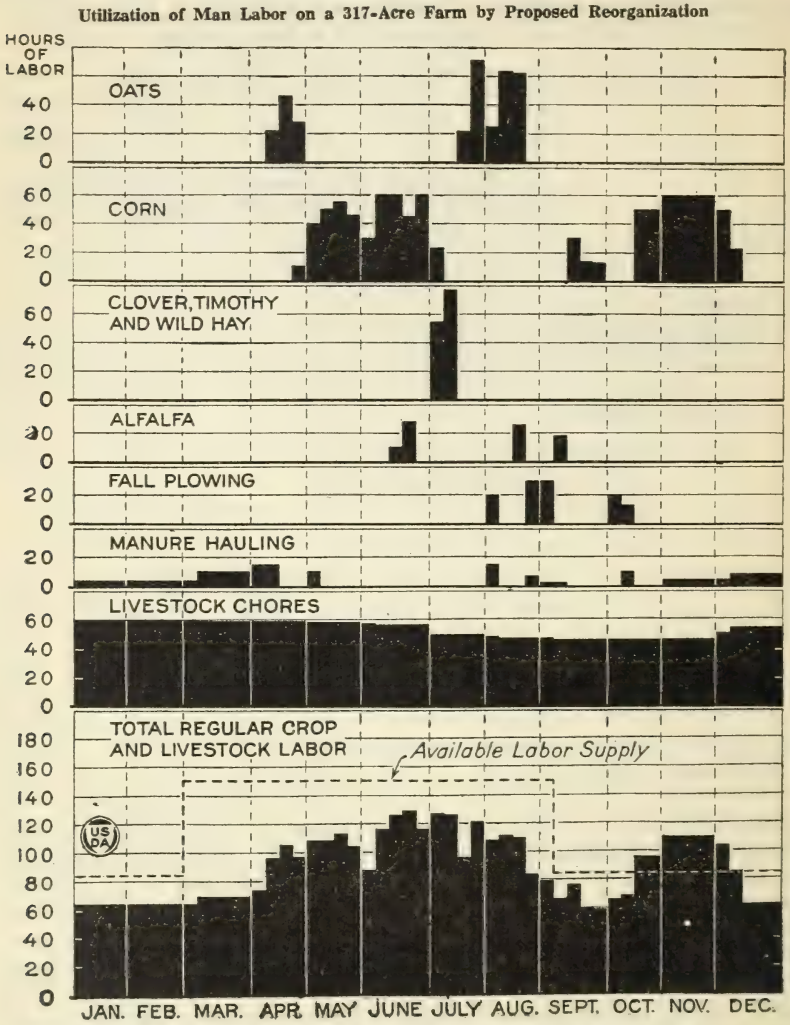
Utilization of Man Labor on a 317-Acre Farm by Proposed Reorganization
HOURS OF LABOR
OATS
CORN
CLOVER, TIMOTHY AND WILD HAY
ALFALFA
FALL PLOWING
MANURE HAULING
LIVESTOCK CHORES
TOTAL REGULAR CROP AND LIVESTOCK LABOR
Available Labor Supply
JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.

FIG. 30.—Many farm tasks of a miscellaneous character can be done at any time and so made to fit in with unforeseeable circumstances that arise on the farm as a result of weather and soil conditions

reduces the risk of the crop failure. Under these conditions there is a possibility of increasing the returns by changing from barley to oats, as shown below.

Oats, 15 acres, 38 bushels per acre, 570 bushels, at $0.30	$171
Barley, 15 acres, 25 bushels per acre, 375 bushels, at $0.40	150
Increase in value of oats over barley	21
Increase in cost of seed, twine, and threshing	2
Added returns from choice of 15 acres of oats	19

This advantage in favor of the oats is too small to be significant and is offset by the element of diversity introduced by the barley crop.

At times the relative prices of grain shift materially, making a change in the acreage of each advisable. The effect of such a change in prices on the farm income is significant in the following example. Assuming that the price of barley has remained the same as in the preceding example and the price of oats to have advanced to 40 cents per bushel, the gain by changing from barley to oats would be as follows:

15 acres of oats, 38 bushels per acre, 570 bushels, at $0.40	$228
15 acres of barley, 25 bushels per acre, 375 bushels, at $0.40	150
Increase in value of oats over barley	78
Increase in cost of seed, twine, and threshing	5
Added returns from the choice of 15 acres of oats	73

It is obvious that this increase is large enough to warrant a shift from barley to oats. Any change in the relative yields of these crops over a period of years with the relative prices remaining the same would affect the profits in a similar way.

Effect on returns of substituting rye for oats as a cash small-grain crop.—Inasmuch as this farm produces small grain for sale, the possibility of substituting rye, which has a relatively higher value per acre, is worth consideration. Using the data on yields and prices given above, the effect of replacing 20 acres of oats with rye would be as follows:

Rye, 20 acres, 18 bushels per acre, 360 bushels, at $0.70	$252
Oats, 20 acres, 38 bushels per acre, 760 bushels, at $0.30	228
Increase in value of rye over oats	24
Extra costs of seed, twine, and threshing	6
Added value from choice of 20 acres of rye	18

The substitution of this acreage of rye for oats would improve the distribution of labor by providing more work during August and September and reducing the amount required in April. It would spread out the harvest labor, as rye comes ahead of the oats and barley, but might conflict with haying or corn cultivation. The rye would require more total labor in the preparation of seed bed, as it is common to plow for rye. However, this comes at a time when there is little other work and could be done without increasing the supply of labor. This change would necessitate the seeding of rye after oats or barley, unless the fodder corn was cut and shocked in time to put in rye. Rye is a better nurse crop for clover and grass than oats, and therefore could be advantageously included in the rotation. However, it does not fit into the cropping scheme as well as oats, because it must be seeded in the fall before the corn crop can be removed.

Effect of a change in the relative prices of rye and oats upon the choice between these crops.—A relative increase in the price of rye over oats might warrant some adjustment in the oats and rye acreages. With

oats at 30 cents a bushel and rye at $1, the returns would be affected as follows:

Rye, 20 acres, 18 bushels per acre, 360 bushels, at $1	$360
Oats, 20 acres, 38 bushels per acre, 760 bushels, at $0.30	228
Increase in value of rye over oats	132
Extra cost of seed, twine, and threshing	15
Added returns from 20 acres of rye instead of oats	117

This would no doubt make it advisable to shift from oats to rye as a cash small-grain crop.

REORGANIZATION PLAN NO. 2

Effect of increased livestock production upon the returns.—The foregoing plan does not provide for any substantial increase in the returns to the farm. The points of greatest weakness in the present organization are in the hog and cattle enterprises rather than in the cropping plan. The plan outlined in Table 62 assumes that the farmer can increase the production of butterfat per cow up to 160 pounds by better feeding and care of the cows and at the same time increase the production of pork up to 20,000 pounds, thus utilizing the skim milk available and marketing through livestock more of the grain produced.

TABLE 62.—*Estimated returns from proposed organization No. 2*

	Acres	Yield per acre	Total yield	Amount required for feed	Salable surplus
Corn for grain	100	40 bushels	4,000 bushels	2,500 bushels	1,500 bushels
Oats	62	38 bushels	2,356 bushels	1,656 bushels	700 bushels.
Barley	15	25 bushels	375 bushels	175 bushels	200 bushels.
Alfalfa	5	3 tons	15 tons	All	
Clover and timothy hay	34	1¾ tons	59 tons	55 tons	4 tons.
Corn fodder	11	2 tons	22 tons	All	

Crop sales:	
1,500 bushels corn, at $0.50	$750
700 bushels oats, at $0.30	210
200 bushels barley, at $0.40	80
4 tons hay, at $10	40
Total crops	1,080
Livestock sales:	
14 cows, each 160 pounds butterfat, 2,240 pounds, at $0.45	1,008
20,000 pounds of pork, at .08	1,600
15,000 pounds of beef, at .06	900
Total livestock sales	3,508
Total crop and livestock sales	4,588
Cost of materials: Crops (see Table 61)	260
Veterinary and medicine:	
Cows	5.00
Young cattle	5.00
Hogs	40.00
Horses	4.00
Total	54.00
Total cost of materials	314
Total returns to the organization after deducting material costs	4,274
Net increase over present plan of operation	735

This plan calls for an increase of 562 hours in the direct man labor on crops and livestock over the present organization. It may also necessitate a slight increase in the maintenance labor required. However, on account of the better seasonal distribution of labor it should not be necessary to have any additional labor to handle this increase. No change in resources is assumed except an increase in

the number of brood sows from 10 to 18. Since the farmer raises his own brood sows, this latter change involves no cash outlay. This increased efficiency in the marketing of crops through livestock will return $735 more to the organization.

Effect upon returns of expanding the dairy enterprise.—A further expansion of the dairy enterprise to 18 cows and an additional increase in the hog enterprise to utilize the skim milk and more of the grain produced would affect the returns as follows:

5,000 pounds additional pork, at $0.08	$400
640 pounds additional butterfat, at $0.45	288
Total value additional product	688
Decrease in sales:	
490 bushels corn, at $0.50	245
250 bushels oats, at $0.30	75
2 tons hay, at $10	20
	340
Increased veterinary and medicine costs	12
Total subtraction	352
Net increase in returns to the organization	336

This expansion of the livestock enterprises would provide for a much fuller utilization of the labor available, because approximately 630 additional hours of man labor would be required. This additional labor would be quite uniformly distributed throughout the year and with good management would not necessitate hiring extra labor, although the increased returns are sufficient to warrant hiring some extra labor if needed. More corn would have to be cut for fodder and more alfalfa grown in order to meet the roughage requirements for the cows. Even then the margin of safety between amounts of hay produced and that needed by livestock is greatly reduced. The effect upon the soil fertility and crop yields of the increased use of grain for feeding instead of sale can not be determined, but it is reasonable to expect some long-time improvement from this source.

Effect on returns of shifting from beef to butterfat production.—Another possibility is the expansion of the dairy enterprise to 18 cows at the expense of the beef enterprise. By reducing the production of beef 3,000 pounds, 4 more cows producing 160 pounds of butterfat each could be kept on practically the same feeds. The relative returns would be as follows:

4 cows, 640 pounds butterfat, at $0.45	$288
3,000 pounds beef, at $0.06	180
Net increase in returns from producing butterfat instead of beef	108

This change could be effected without hiring additional labor or reducing the margin of safety between the feeds being produced and those required for the stock. It would, however, require 400 additional hours of work on the part of the family.

SUMMARY

The examples given illustrate a method of using unit-requirement data in planning the farm organization. With these data available, it is possible to project with a reasonable degree of accuracy operations for a year on the farms of this area and to estimate the probable variations in returns that may normally be expected, as well as the variations in the outlay to be made if each of the several probable alternatives is chosen.

The unit-requirement data can also be used by farmers in other areas operating under conditions similar to those prevailing in this area. The description of the farms studied and the history and description of the Windom area enable farmers located elsewhere to determine to what extent their conditions are sufficiently comparable to make the data applicable to their problems.

The individual farmer must study the relative opportunities offered by all possible alternatives in order to determine that plan of organization which promises the largest return to the resources at his command. Other factors than the securing of the highest returns from farming may affect the choice of farm enterprises. The farmer's likes and dislikes or the effect of changes in organization upon the farm as a home and other noneconomic factors may influence his decisions. In any event the actual working out of the farm organization plans will serve both as a check upon what has been accomplished and as a guide to future possibilities. Knowing this, it is for the farmer to decide whether the increased returns that may be secured from changes in organization are sufficient to induce him to make the changes.

The returns from any organization plan are calculated on the basis of probable future prices. Prices of all commodities are constantly shifting, sometimes erratically, sometimes in fairly definite cycles. These changes may be frequent and rapid, or they may be relatively few and gradual. There is a considerable tendency for the farmer to base his plans for the coming year on the prices received for his products during the present year. This practice always involves a large element of risk, because a high price for a given commodity one year may stimulate an overproduction of that commodity the following year so serious as to reduce its price and make its production highly unprofitable. At the present time the farmer can safely adjust his business in response to price changes only in so far as these changes appear to be due to relatively permanent changes in economic conditions. However, there are now a large number of both public and private agencies giving considerable attention to price forecasting. As these agencies collect information covering the factors that determine price and the farmer learns to interpret it or has it interpreted for him, it will be increasingly possible for him to use price forecasts in connection with the method of analysis outlined in this study.

It is without the realm of this study to go into the question of price making or the possibility of artificial regulation of prices. However, it is suggested that the proper consideration of the problem of choice and adjustment of enterprises by farmers will lead to a more rapid and accurate adjustment of production to the ever-changing conditions of the market. This will mean more stability as between the relative prices of different agricultural products. The proper consideration of the probable returns that may be secured from different types of farm organization plans may also result in a more rapid adjustment between agricultural production as a whole and production in other industries. The process of analysis outlined in this study will help individual farmers decide whether the returns from farming are sufficient to keep them in the business; and, if so, what to produce and how to produce it.

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